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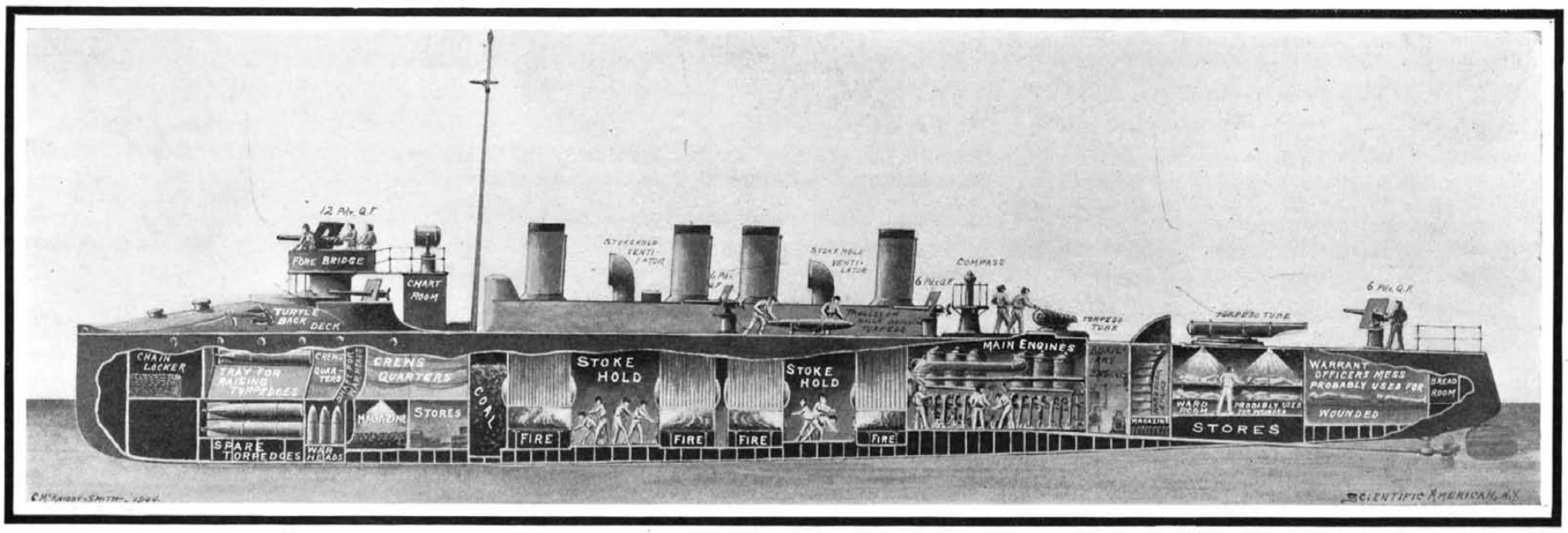
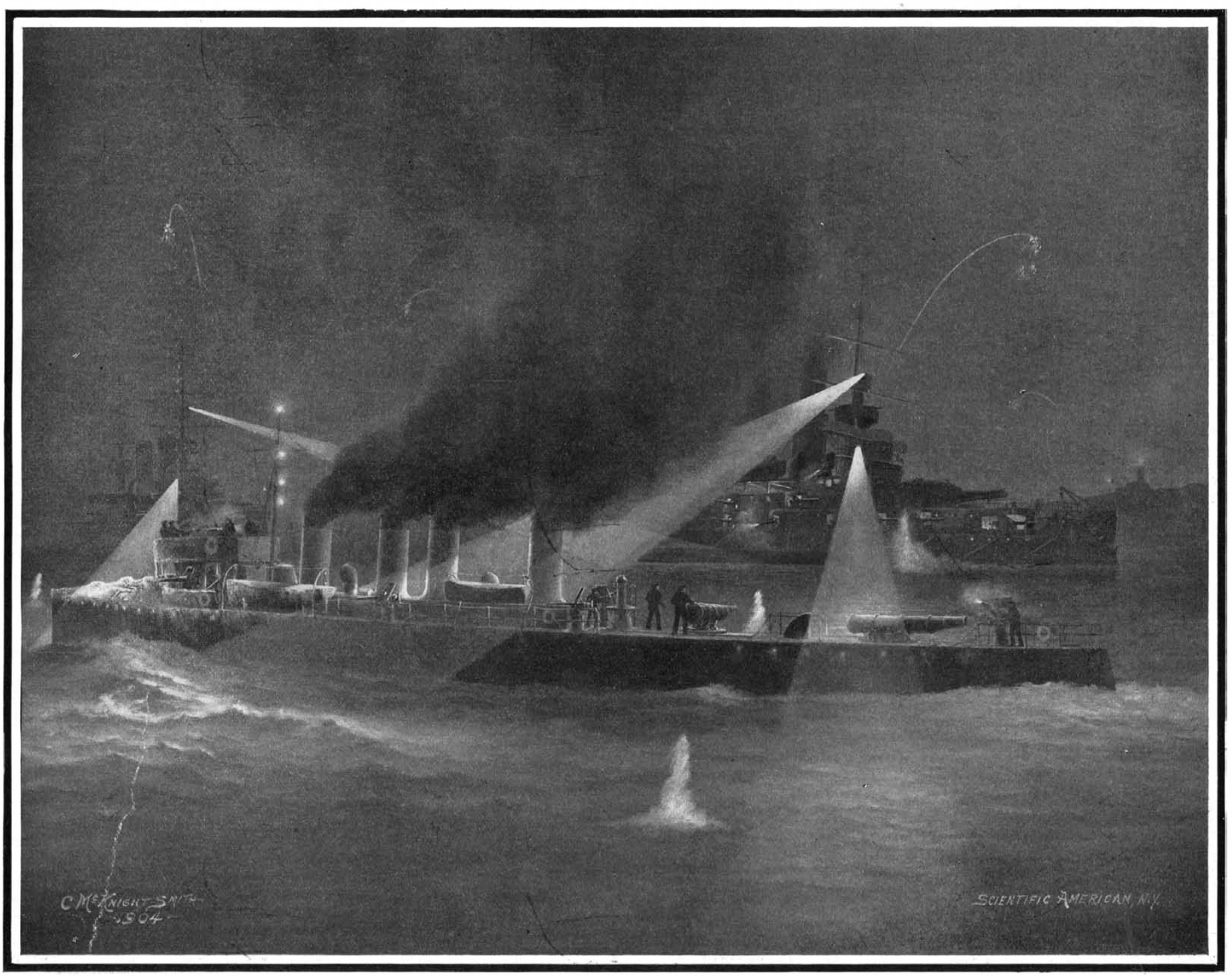


Sectional Diagram, Showing the Interior of a Japanese Torpedo-Boat Destroyer.



Fleet of Battleships Surprised by Night Attack of Torpedo-Boat Destroyers.

THE TORPEDO BOAT IN MODERN WARFARE.—[See page 387.]

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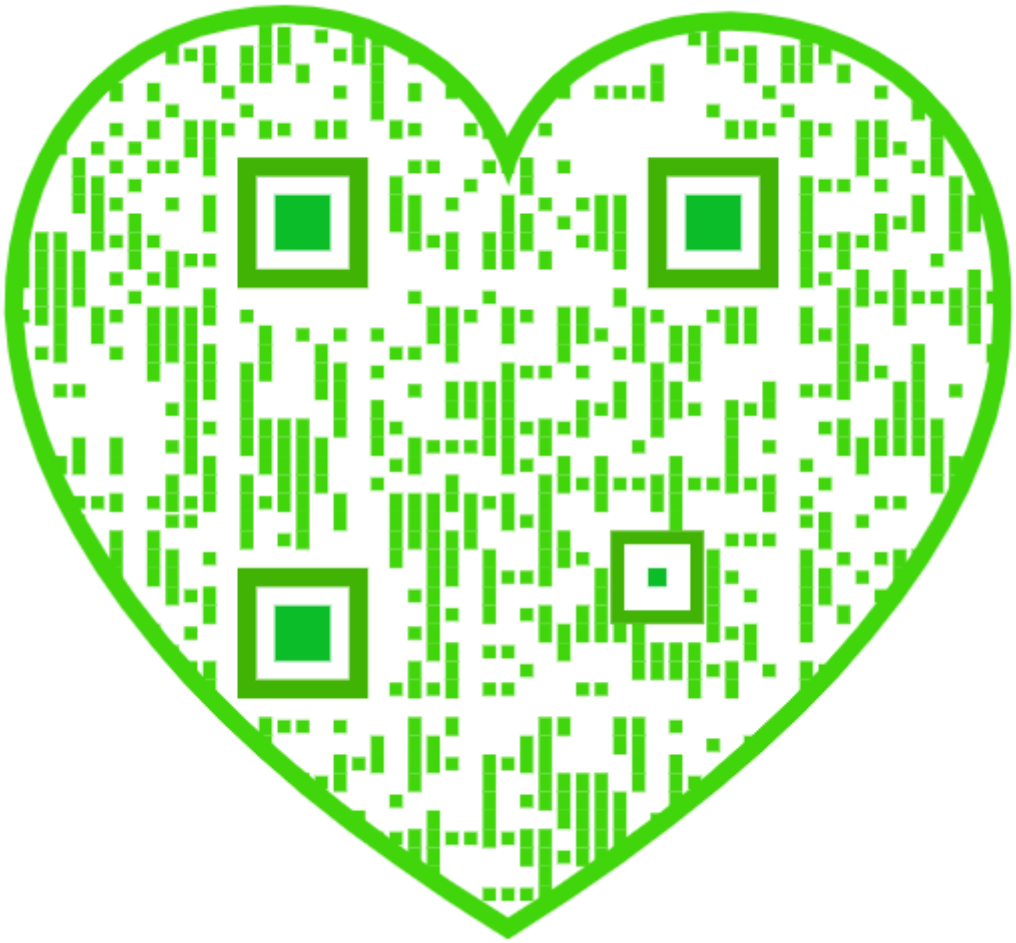

SCIENTIFIC AMERICAN

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NEW YORK, SATURDAY, MAY 14, 1904.

The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

ELECTRIC TRACTION TESTS AT THE WORLD'S FAIR.

One of the most valuable features of such great industrial exhibits as that now being held at St. Louis is the series of elaborate tests of machinery and general industrial appliances. These are carried out by boards consisting of some of the best-known experts in their respective departments; and the special facilities afforded, the magnitude of the plants upon which the tests are made, and the abundance of time available, render the results of the highest scientific and commercial value. Among the most elaborate of these tests are those that have been projected by the Louisiana Exposition Commission in connection with electric traction. These are to be divided into three classes. First, those which will be made in the Electricity Building; secondly, those made on special tracks laid for the purpose within the Exposition grounds; and lastly, a series of trials which will be carried out on a lengthy stretch of line outside of the grounds, to throw further light upon the question of high-speed traction. The experiments are intended to cover in a very complete way the equipment and operation of city and suburban railroads, of interurban roads, and the operation of heavy standard trains, such as run on the trunk railroads of the country. The tests that are made within the Electricity Building will be, to all intents and purposes, shop tests, the various materials and plant selected being subjected to the same inspectors and controlled by the same rules—an arrangement which will make it possible to co-ordinate and compare results in a thoroughly scientific and satisfactory manner. The tests carried on outside the building are to be made under actual operative conditions. It is expected that all the great electrical manufacturing companies will be represented, and a more complete collection of electrical plants and apparatus will be gathered together than was ever before assembled. It is hoped to supplement and carry to an even more advanced point, the valuable high-speed electrical tests made last year on the Berlin-Zossen line, when, it will be remembered, a speed of over 130 miles an hour was recorded.

TURBINE OCEAN STEAMERS.

Although the construction of the great turbine-propelled liners for the Cunard Company overshadows in public interest every other marine turbine development just now, it is a fact that there will be some splendid specimens of turbine ocean liners in service on the high seas long before the Cunard vessels are in the water. Mention should be made incidentally of the "Turbinia," which was launched not very long ago in Great Britain, and will soon cross the Atlantic for service on Lake Ontario. Before many weeks a large ocean steamer, the "Tasmania," will be dispatched to Australia, and the Allan Line will place two turbine-driven liners in the Atlantic service of the company. Next year, moreover, a turbine-driven Cunard steamer of about half the tonnage of the 25-knot 40,000-ton turbine ships will be plying between Liverpool and the United States. Considering that the practical turbine is but a decade and a half old, this must be considered a remarkably rapid development of what is commercially considered an entirely new type of steam engine.

NEW SYSTEM OF TUNNEL CONSTRUCTION.

Probably the most original piece of engineering work along the whole route of the Rapid Transit Subway is the tunnel which is being built beneath the Harlem River. The method adopted is, as far as we know, entirely new in a work of this character, and, like many another development in engineering, it is the outcome of local conditions of extreme difficulty which demanded some other methods of construction than those commonly adopted. These conditions arose from the comparatively shallow depth at which it was necessary to build the tunnel in order to avoid excessive grades at the approaches, and the extremely treacherous nature of the material encountered at this depth. The silt is so loose that tunneling by the Beach shield system would have been very hazardous, if not, indeed, altogether out of the question, and accordingly the contractor, Mr. D. D. McBean, hit upon the plan of driving two parallel lines of sheet piling, spaced a little wider apart than the width of the completed tunnel; bulkheading each end of the structure; and covering it with a heavy water-tight timber roof, the interior being then pumped dry of water, and the inclosed mud excavated down to grade under the pneumatic system. This was the method adopted in crossing the first half of the river on the Manhattan shore. For the second half the contractor followed the same principles of construction, but made a considerable advance in point of rapidity and cheapness of erection, by driving the two parallel walls of sheet piling, cutting them off at the level of the longitudinal axis of the tunnel, building the upper segmental half of the cast-iron lining in lengths of 70 to 80 feet upon pontoons, floating it over the sheet piling, lowering it until its flanges rested upon the piling, with which it made a water-tight joint, and letting this finished half of the tunnel serve as the roof of the temporary cofferdam. When the water is pumped out the mud is excavated to grade, the lower half of the cast-iron shell is built in place, bolted to the upper half and calked, and the tunnel is completed.

There can be no question of the economy of this method of construction over that which it supersedes; and it has the great advantage that the tunnel may be built with its upper surface practically at the highest line allowed by the War Office in navigable waterways. The vertical stability of the tunnel, a question which is causing much anxious thought on the Pennsylvania tunnel, is assured by driving along the line of the tunnel as much piling as is necessary to support the structure, this work being carried out before the lateral walls of sheet piling are put down. The question of the applicability of this system in the construction of tunnels across the East and Harlem Rivers would hinge upon the amount of interference to navigation that would be caused by the temporary staging platforms that would be necessary during the construction of the various sections of the tunnel; but it would seem that these stagings might be so widely separated as to cause but little interference with navigation.

OUR AVAILABLE IRON-ORE SUPPLY.

The falling off in demand for iron ore and iron-ore properties last fall, incident to the slackening of general business and the curtailments by the iron manufacturers, principally the United States Steel Corporation, has in a measure obscured the real facts as to the relation of consumption to available iron-ore supply and put a damper on the wild rush for iron properties which prevailed in 1901 and 1902. The sagging in the iron trade has not changed the facts, nor have there been made within recent years any discoveries of available iron ore that will materially postpone the day when the great iron industry of the country is to be brought face to face with the problem of supplying the vast and increasing amount of ore annually consumed. About five years ago, U. S. Geologist C. R. Van Hise predicted that inside of a decade the standard of marketable ore from the Lake Superior district would be between 50 and 60 per cent of iron content, instead of over 60 per cent, the then prevailing limit. The condition has been realized in less than half a decade, and there is a prevailing opinion that an even lower standard for merchantable ore in the Lake Superior country is even now at hand. Considerable ore between 40 and 50 per cent in iron was mined at Ishpeming (Michigan) last year, and iron men no longer look away from the "low-grade" properties as formerly. This lowering of the standard has increased the available supply considerably. It has been due partly to the advantages of cheaper mining and transportation and improvement in furnace practice, but it is a certain indication of the realization by the iron consumers that there is a limit to the amount of high-grade ore in the Lake Superior district. The chief consideration in the situation is the Lake Superior supply, since from that district in 1902, 79 per cent of the iron ore production of the United States came, and in 1903 an increasing proportion. The older eastern and southern districts do not hold any large ore reserves, and the newer districts are as yet all uncertain or unavailable.

From the standpoint of the Lake Superior supply, an interesting estimation as to the available iron ore of the whole country can therefore be drawn. Estimates made by the United States Geological Survey in 1902 of the amount of merchantable ore in sight, that is ore above 59 per cent in iron, give the ore reserve in the Mesabi district as 500,000,000 to 700,000,000 tons. The aggregate of ore in sight in all the other Lake Superior districts is placed at 350,000,000 tons. Explorations since this estimate was made have not materially increased these reserves. It is fair then in the light of the present known facts about the iron-ore supply in the Lake Superior districts to place the available reserve at 1,000,000,000 tons of 59 per cent ore. With this as a basis and the figures of annual consumption as a measure, the time of the exhaustion of these iron-ore reserves can be estimated. The production of the Lake Superior mines in 1890, 1901, 1902 averaged about 8,000,000 tons; in 1893 it fell to 6,000,000. Since that time it has increased at about 2,500,000 tons a year. The production in 1902 was 27,869,000 tons, and in 1903 24,300,000 tons, to use round figures. Take this as indicating a present yearly demand for 25,000,000 tons, and allowing for no increase, the visible ore would be exhausted in forty years. Allowing for an average annual increase of five per cent, which is a fair increase deduced from the years since 1899, and is within the estimated general increase of business for the country, not allowing for the yearly enlargement of the uses of iron in all lines, it can be arithmetically computed that the available ore estimated will be all exhausted in twenty-three years!

On the other side of the question is the possibility and probability that iron ores below 59 per cent will be utilized in the near future. This will largely increase the available supply, but how much cannot be estimated, as these "low-grade" ore bodies have not ordinarily been explored. Then there is a fair certainty that new ore bodies will be located within the districts now worked for ore. These new bodies cannot be very large, nor can they affect the supply in any such manner as the finding of the Mesabi, for instance, did; but these undiscovered ore bodies are to be considered as a factor in the problem of ore supply. There is also a chance that new iron districts will be opened in this region. The new Baraboo district in Wisconsin, though not up to predictions, has added perhaps 7,000,000 tons to the available ore. Explorations in Canada on the Anticoken range and on the western extension of the Mesabi give some promise of new sources of supply. The recent discovery of a new iron district in Aitkin and Crow Wing counties in Minnesota may be of importance. These new districts, however, have not, since the discovery of the Mesabi in 1893, come up to the expectations. Notably has the Michipicoten district in Ontario failed to realize the hopes of its discoverers. The other iron ore deposits in eastern Ontario are uncertain as to extent also.

So we have a possibility that within a quarter of a century the Lake Superior mines will be unable to meet the demands for a high-grade ore.

The western deposits are a factor in the future, but most of these are at a disadvantage as to transportation. In fact, they are all cut off from the eastern consumption by the necessarily high freight costs. The consumption of iron produced in the western furnaces may supply the local demands, and relieve the demand on eastern furnaces to this extent. It is generally believed that these western deposits are not generally so extensive as claimed, and further that with depth the ore will become valueless, by reason of the increasing sulphur content from the sulphides from which all of these ore bodies, except perhaps those in Wyoming, are derived. The iron ore in Mexico may be an important factor at no distant date. The deposits available to the Pacific Ocean are now being secured by American capital as a supply for proposed furnaces at American Pacific ports, and an iron property near Vera Cruz is preparing to ship ore to the Atlantic ports, to be consumed with the relatively small amount of Cuban ore now imported for this market.

But the fact is, that but for the bountiful supply of cheaply mined and transported ore from the Lake Superior districts, the wonderful progress of the country in industrial lines would not have been possible, and it will be necessary to figure on the day when the Lake Superior supply will be exhausted or be of a lower grade, except as to reserves held by special interests. Since the United States Steel Corporation controls more than 70 per cent of the visible ore in the Mesabi district, all of the developed mines in the Vermilion district, 60 per cent of the Penokee-Gogebic district, and 50 per cent of the Marquette and Menomonee districts, the problem for the independent consumer of ore is made more imminent than the general considerations indicate.

ON SOME NOVEL N-RAY PHENOMENA.

Prof. Blondlot actively continues his investigations of N-rays, and in a paper recently read before the French Academy of Sciences, we note some interesting facts. The author some time ago observed that sources of light under the action of N-rays would show an increase in brilliancy. Now, Blondlot thought it interesting to ascertain whether the same phenomenon occurs in the case of a body reflecting the light from an external source or from an illuminant proper. The following experiment was accordingly made: A ribbon of white paper, 15 millimeters in length and 2 millimeters in breadth, was fixed vertically to an iron-wire support. The room being darkened, the paper ribbon was feebly illuminated by a lateral beam of light emerging from a vertical slit in a box inclosing a flame. The N-rays from an Auer burner, traversing a rectan-

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gular slit in front of this slit, would strike the paper ribbon. Now, if the rays were intercepted by interposing either the hand or a lead plate, the small paper rectangle would be darkened, and its outline lose in distinctness. As soon as the screen was removed, both the brilliancy and distinctness would reappear, thus proving that the light diffused by the paper ribbon was increased by the action of N-rays.

Now, the diffusion of light is a complex phenomenon where regular reflection plays the part of an elementary fact. The author therefore thought of investigating whether the reflection of light is also modified under the action of N-rays. For this purpose a polished knitting needle of steel was placed vertically in the position previously occupied by the paper ribbon. In a box completely closed but for a vertical slit at the height of an Auer lamp (shut by a screen of transparent paper), a flame was placed so as to illuminate the slit. By placing the eye at the slit, the image of the latter formed by reflection on the steel cylinder was distinctly seen, while the reflecting surface was struck by N-rays, the action of the ray seeming to strengthen the image. Similar results were obtained when the needle was replaced either by a plane bronze mirror or a polished quartz surface. All these effects of N-rays require an appreciable time both to be produced and to disappear. On the other hand, no action of N-rays on refracted light could be observed, though various experiments in this direction were undertaken under many different conditions.

As the capacity of seeing small variations in candle power varies for different persons, these phenomena are nearly at the limit of perceptibility to some persons, who only after a certain practice will be able to observe them regularly and safely, whereas others will at once and without the least difficulty note the strengthening effect of N-rays on the candle power of a small illuminant. Now, as the author has recently observed the same phenomena with considerably increased intensity when replacing the Auer burner by a Nernst lamp, these phenomena may now be produced with such intensity as to be visible to anybody.

INDUCED RADIO-ACTIVITY AND ALUMINIUM.

BY DR. M. METZENBAUM.

It has been stated that if a sealed tube containing radium of high activity be suspended in a normal salt solution, and solutions containing various drugs, these solutions become radio-active and are capable of affecting photographic plates. It has further been intimated that if radium has a therapeutic value, then these solutions, which have been rendered radio-active, might likewise have a therapeutic action; and that since solutions can be taken internally, the possibilities of these radio-active solutions might be of considerable value. In view of these statements, I conducted a very large series of experiments, from which the following negative results have been obtained:

Two tubes of radium of 1,000,000 activity, each containing 5 milligrammes, and two other tubes of lesser activity, each containing 50 milligrammes, were placed in a normal salt solution and remained there for ten days. This solution was placed in test tubes of very thin glass and in the small vials in which hypodermic tablets are contained. These were then strapped with adhesive plaster to the film side of photographic plates. Some of the plates had first been covered with black paper. The tubes were thus maintained from a period of twenty-four hours up to twenty-one days, and in no case was there the faintest sign that the photographic plates had been affected.

It has been known for a long time that aluminium offers very little resistance to the rays of radium and radio-active substances. I therefore took many boxes made of very thin aluminium, filled these with so-called radio-active solutions, and placed them on photographic plates covered with black paper. But in no instance, even after ten days, was any image obtained.

Then aluminium boxes were filled with these solutions and placed on the bare photographic plates, and after forty to forty-eight hours a very definite outline of the boxes was obtained. Stimulated by this last observation, which I then considered a correct one, as indicating a result due to the so-called radio-active solutions, I practically completed a series of ninety-six experiments, from which I made the following inferences, which would be very gratifying if true, but as I will soon show, are incorrect:

First.—A normal salt solution becomes radio-active, as proven by the outline of an aluminium box containing this solution, when this box is placed on a bare photographic plate for forty to forty-eight hours.

Second.—A saturated salt solution becomes more radio-active than a normal salt solution.

Third.—As the amount of salt in the solution is increased, so is the induced radio-activity.

Fourth.—A tube of 10 milligrammes of 1,000,000 activity does not induce a greater amount of radio-activity into a salt solution, than does a tube of 20 milligrammes of 7,000 activity, or a tube of 15 grains of 40 activity. From this it seemed as though a salt solution could be rendered radio-active to a certain degree only.

Fifth.—The radio-activity seemed to be just as great after a tube of radium was suspended in a salt solution for ten hours, as it was after the tube of radium had been kept in the salt solution continuously for three weeks.

Sixth.—That a tube of radium could be placed in some salt, and if this salt were made into solution, it would retain its radio-activity.

Seventh.—That this radio-activity is not lost after several weeks.

If all of these inferences had not been overthrown, and if these radio-active solutions had any therapeutic action, then surely these results would have been of great value, for it would be possible to transport these solutions, or to render substances radio-active, and to apply them. A tube of radium costing a few dollars would accomplish the same result as a tube costing $250.

When these aluminium boxes were placed on the photographic plate, they produced only an outline of their rim. This I explained by the fact that they were slightly concave, and affected the plate only at the points of contact. It was also noticed, no matter what solutions the boxes contained, that there was always about the same amount of print for the same length of time. I had also noticed that distilled water, when submitted to the tubes of radium, produced the same amount of print. This caused me some doubt; for I believed it to be the solids in the solution which became radio-active. Then aluminium boxes filled with these salt solutions and empty ones were placed on the reverse side of the photographic plates. They did not affect the plates after a period of ten days.

During the entire series no aluminium box had been used more than once, for I soon observed, if a box had contained any of these solutions or any radio-active substance, no matter how much I cleaned it or boiled it, the box still affected the photographic plate, while the steel keys, which had been covered with the various uranium salts, and thorium, if they were cleaned thoroughly, would not affect the photographic plate. These boxes were always kept in a place where I considered them out of the influence of all radio-active substances.

These observations forced me to seek for an error. This action of metallic aluminium on the photographic plates I concluded must be sought for in the boxes themselves. Several empty boxes were placed on bare photographic plates, and after forty-eight hours they gave as good prints as if they had been filled with the solutions. I thought that somehow they might have been rendered radio-active. Some new boxes were then obtained and placed on bare photographic plates. After forty-eight hours these also affected the plate, as well as many other new boxes.

The next questions which presented themselves were:

First.—Is the particular product of aluminium, from which these boxes are made, radio-active?

Second.—Is all aluminium radio-active?

Third.—Is the action of aluminium on photographic plates due to radio-activity, or some other cause?

Fourth.—If this action of aluminium on photographic plates is not due to radio-activity, to what, then, is it due?

Fifth.—What action will aluminium salts have on photographic plates?

Summary: Many aluminium articles were placed on bare photographic plates, and in every instance they produced their own image in forty-eight to ninety-six hours.

The same aluminium articles, when placed on photographic plates covered with black paper, did not produce an effect on the plate in ten days. The same aluminium articles, when placed on the reverse side of the photographic plate, or when separated from the film by a plate of glass, did not affect the plate in ten days.

The summary of the experiments of placing aluminium salts, of which there are many, on bare photographic plates, is that in no instance was the plate at all affected after ten days.

The inferences to be drawn are:

First.—When metallic aluminium is placed on the bare photographic plate in the dark, it will produce its own image.

Second.—That aluminium will not affect the photographic plate, when separated from the film of the plate by black paper, glass, or when placed on the reverse side of the plates. Therefore, aluminium is not radio-active.

The action of metallic aluminium on photographic plates is probably either a chemical action or an electrical action between the metal and the albuminate of silver of the plate. This observation, that metallic aluminium when placed on a bare photographic plate produces its own image, has heretofore not been pointed out. Tubes of radium were placed in various powders, as bismuth subnitrate, for several days; then these powders were placed directly on the film of the plate, and in no instance, even after ten days, did they show the slightest effect on the plate.

These conclusions give positive proof that by suspending tubes of radium of varying strength, for long periods, in various solutions and various powders, neither the solutions nor the powders are capable of affecting photographic plates. Nor was it possible to show the supposed induced radio-activity by means of an electroscope.

SCIENCE NOTES.

M. Chevalier, the eminent French explorer, has recently returned from prolonged travel in Central Africa. He has secured a valuable collection of interesting documents and photographs of the country and its people. Furthermore, he carried on his travels a phonograph, upon which he has secured records of the languages of the various natives in the region which he explored, made by the natives themselves. These records will be reproduced by Mr. Chevalier in the course of his lectures describing his travels, experiences, and discoveries.

A French inventor, M. Heit, has devised a new type of compass, which is automatic in its action. By means of this contrivance, the direction of the compass is automatically registered minute by minute, so that by consulting the chart which is thus produced the ships' officers can ascertain the exact route traversed at any time of the passage. In the Heit apparatus the compass card, instead of having at its center an agate resting on a fixed steel point, is fixed on a steel pivot which rests on a fixed agate. The latter is immersed in a drop of mercury, which serves to conduct the current of electricity that renders the registering of the movements of the compass possible. To perform this function, a small silver index, kept in constant electrical communication with the pivot by a fine and flexible wire, is attached to the card. Normally, this index does not touch the fixed basin surrounding the card, but by means of the electrical current the circuit is rapidly closed and opened, with the result that the angle of the boat with the meridian is registered. For this purpose the basin is divided into a certain number of sections, isolated from each other and corresponding in each case to a special circuit, the registration being made on a sheet of paper by means of a spark produced by a small induction coil. The apparatus also registers the speed of the boat by recording the revolutions of the screws, at each stroke of the piston a current being closed and a signal sent to the receiver.

Mr. Percival Lowell, director of the Lowell Observatory, speaking of what constitutes satisfactory or unsatisfactory vision of the celestial bodies, says, in substance: Studies directed to that end have resulted in a knowledge of the conditions which constitute good or bad seeing. . . . The basis of the matter lies in the well-known fact that systems of waves traverse the air, several of these systems being present at once at various levels above the earth's surface. The waves composing any given system are constant in size and differ for the different currents all the way from a fraction of an inch to several feet in length. If the distributing wave be less from crest to crest than the diameter of the object glass, the image is confused by unequal refraction from the different phases of the wave; if the wave be longer than this, a bodily oscillation of the whole image results. The first is fatal to good definition, the second makes accurate micrometric measurement difficult. It is easy to make these waves visible by taking out the eyepiece and putting one's eye in the focus of the instrument when the tube is pointed at a bright light. It is further possible to measure their effect by carefully noting the character of the spurious disk and diffraction rings made by a star, and the extent of the swing of the image in the field of view. By combining the amount of confusion with the degree of bodily motion of the resulting image the definition at any time and place can be accurately and absolutely recorded. The perfection of the optical image of a star testifies to the lack of damaging currents with reference to the object glass used. It records all the waves below a certain wave length. Similarly, the amount of bodily motion registers all those above that length.

The biggest carving knife ever manufactured may be seen at the World's Fair. This monster blade is 30 feet in length and has an edge as sharp as a razor. It is made out of the finest steel, and the handle is a masterpiece of the cutler's art, elaborately carved and beautifully polished. It would take a veritable giant to wield a knife like this. The blade is altogether of American manufacture, and it is expected to show for the first time that American cutlery has now reached a point of perfection where it fears no rivalry. The giant carving knife cost several thousand dollars, and special machinery had to be made before its construction could begin. No such knife was ever before manufactured.

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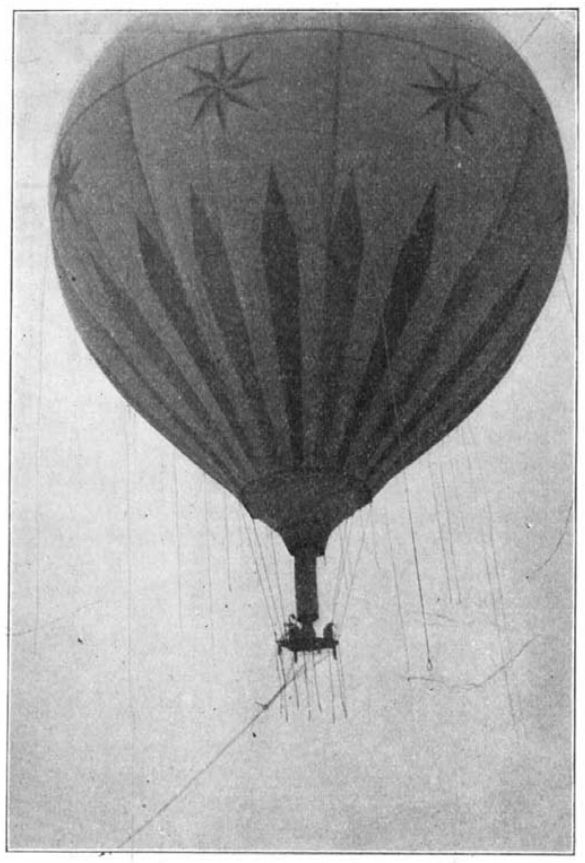
NEW METHOD OF INFLATING BALLOONS IN WAR TIME.

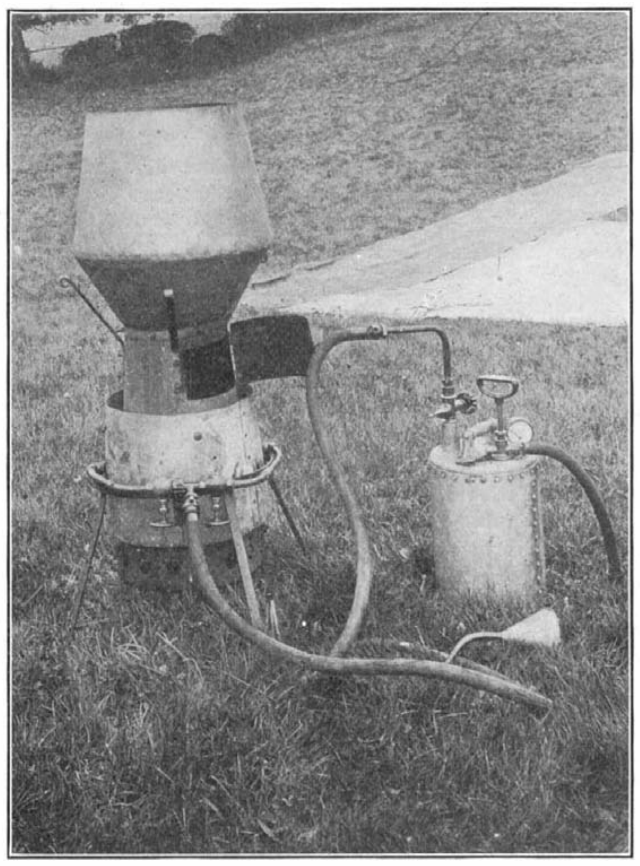
BY EDWARD J. FORSTER.

At the present moment, when attention is naturally attracted to every phase of war, a development of ballooning which will tend to simplify the use of balloons in war time, and add immensely to their value, deserves both a description and an explanation. The improvement is due to the ingenuity of Mr. J. Nevil Maskelyne. It occurred to Mr. Maskelyne that though hot-air balloons were no novelty, in fact they have been more or less familiar to the public for a century, yet for practical purposes, the hydrogen or gas-filled balloon was the only one generally used. He determined to experiment with hot-air balloons, filling them by means of vaporized petroleum or crystal oil.

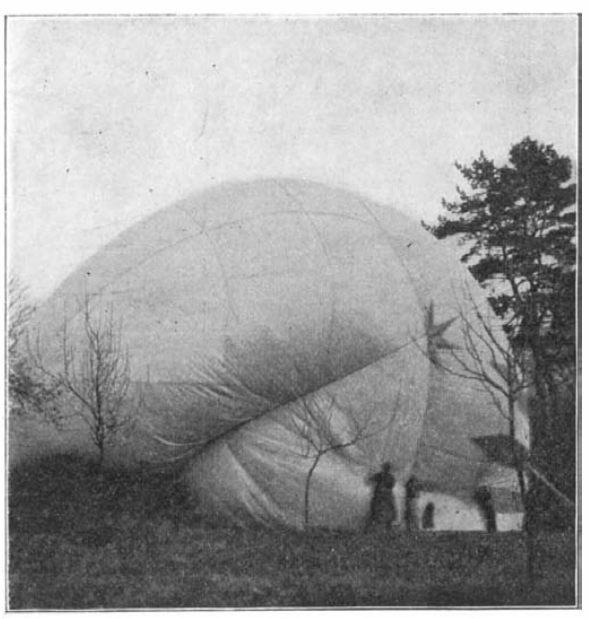
He at once called in the active co-operation of a widely-known and most successful aeronautical scientist, the Rev. J. M. Bacon. Together these two gentlemen, through a long series of experiments, succeeded in demonstrating not only the practicability of inflating balloons in this way, but also in proving what immense possibilities wait on the new discovery. The method followed is briefly this: A specially-constructed vaporizer or burner with an oil consumption power of eight gallons per hour is placed in a staging, above which is held the envelope of the balloon, connected with the burner by a flexible asbestos tube. When the vaporizer is working at full power, the balloon expands with marvelous rapidity. For instance, the balloon shown in our interesting series of photographic illustrations is an enormous envelope of 70,000 cubic feet capacity, having a diameter of 50 feet, and a height of nearly 70 feet; yet this bag is fully inflated well under half an hour. Fully to realize the rapidity of inflations, it is necessary to note the illustrations which show the different stages. Even to the uninitiated it will occur that such a method of inflation must mean much in time of war. Petroleum is a commodity obtainable almost anywhere—cheap, portable, and readily used in the manner indicated. The balloon envelope, the car, the vaporizer, and pump all together are brought down to size and weight which makes the problem of transport easy of solution. One very successful experiment was the inflation of a small balloon of 2,000 cubic feet capacity with a camera attached, electrically connected by means of the cable holding the balloon captive, thus allowing photographs to be taken of the surrounding country. The balloon can be inflated, the ascent made, the photograph taken, and the balloon brought down again all in two minutes.



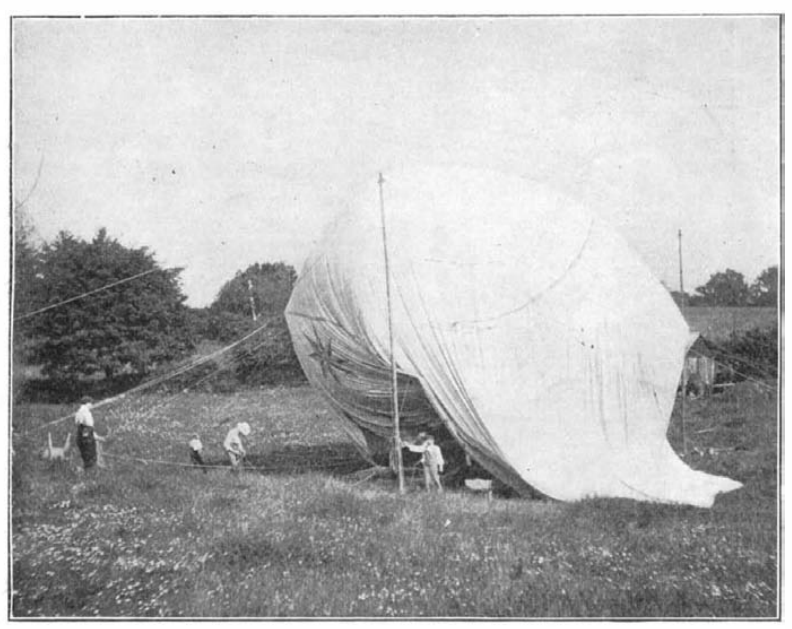
The Balloon Fully Inflated.



The Burner, Vaporizer, and Pump for Vaporizing the Oil.



The Balloon Partially Inflated.



Inflating the Balloon.

An improvement in car seats has been made by B. Repsdorph, of Houston, Texas, by which it is possible to make a very comfortable bed out of an ordinary car seat. The inventor thinks his patent will be a boon to the colored persons of his and other southern States where they are not allowed the privilege of the cars occupied by white persons. The seat itself is but little different from that of the ordinary design, but it is supplied with a lock which holds it rigidly after it has been made up into a bed.

Experiments with Aluminium Alloys.

The Aluminium Company of Neuhausen, Switzerland, having requested the Material-testing Bureau of the Zurich Polytechnic to make for them a series of tests of aluminium-bronze, as also to discover what influence certain given additions of aluminium will exert upon the peculiar properties of brass, we give from the Metalarbeiter the following results. Up to a certain point brass becomes harder as the aluminium is added, after which it becomes rapidly softer again.

For the softer alloys the point of maximum stability or strength is reached with about 3.4 per cent of aluminium, for the harder alloys with about 1.4 per cent.

As the amount of aluminium increases, the tensile strength of brass decreases; in fact, more than two per cent of aluminium will render it too weak for any useful purpose. The experiments were not carried far enough to determine whether the brass would recover its lost tensile strength by the further addition of aluminium.

Small additions of silicon considerably increase its hardness, and also greatly diminish its resistance to the tearing strain. Iron is not present in sufficient quantity to have any perceptible influence upon the characteristics of the alloy. The effect of the different combination of the alloys upon the peculiar tenacity of the same is recognized from the facts that with the increase of the percentage of aluminium from 5 per cent to 10 per cent, the stability or hardness increases, but the resistance to the parting strain decreases.

A combination of iron and silicon acts in exactly the same way. Furthermore, the experiments showed that the 10 per cent aluminium bronze, which contained also a compound of iron and silicon equal to 1.5 per cent of the whole, was too brittle for practical use, as was exemplified by the low resistance to the tearing strains, as well as the tests under the hammer and the cold breaking tests.

In the cold breaking tests several of the aluminium bronzes demonstrated considerable toughness, which corresponds to the resistance to the pull in the tearing process. Those samples which were tested while red-hot disclosed an excellent degree of toughness for all the aluminium bronzes which were heated to about 600 deg. C.

The results for ductility of cast metal are given below. Pure aluminium is malleable cold, as are aluminium bronzes in general, and yet if the aluminium be increased in the alloy the ductility becomes less and less, until with a 10 per cent addition the possibility of beating out the alloy ceases altogether. The presence of from 2 per cent to 3 per cent of silicon renders these bronzes very brittle when cold and next to impossible to bring into any shape.

When heated, however, aluminum bronzes are very plastic, soft, and moldable, and consequently malleable and roll out well; they satisfy the highest demands as to drawing, spreading out in sheets, splitting, and punching. The most favorable temperature for ductility is light cherry red. Increase of aluminium or silicon lowers the required forging temperature.

Under the tests for abrasion by rubbing upon a good and continually oiled cast-iron disk, the harder aluminium bronzes, those with less than 89.6 per cent of copper, showed less wear than two other bearing-metals which were tested at the same time; but quite the contrary was the case with the softer aluminium bronzes.

Bronzes with less than 6 per cent of aluminium became hot at once and rubbed off rapidly.

From this we see that the employment of aluminium bronze for bearing metal is not beyond all possibilities. The material which offers the most favorable properties of stability for rolling purposes is that combination which contains between 8 per cent and 10 per cent of aluminium and silicon. Where more than 10 per cent is present, the product is too brittle, and with less than 8 per cent the stability is very low. The influence of iron is less marked. Those aluminium bronzes which showed the greatest extension in the tearing process proved to be also the toughest in the cold breaking tests. In the red-hot breaking tests all bars were bent 180 deg., and at the bend pressed completely together. In this test only two samples showed traces of cross rupture.

Over four hundred applications in land condemnation proceedings have been filed in St. Louis and Lake counties of Minnesota by the Minnesota Canal and Power Company, which proposes to impound the headwaters of the St. Louis River, for the purpose of supplying electricity to Duluth and vicinity. These applications cover the properties through which a proposed canal will run, and the operation will, it is announced, be a gigantic one, although the details have not yet been announced. Application has been made to the government for portions of many properties which have not yet passed out of its hands.

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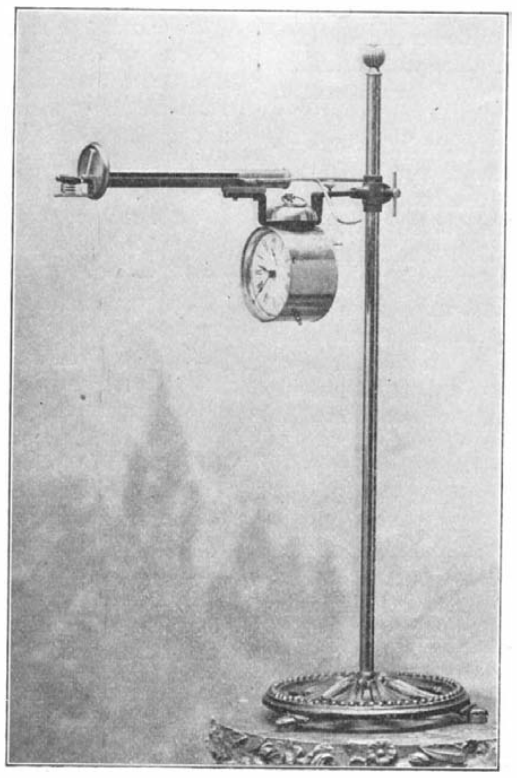
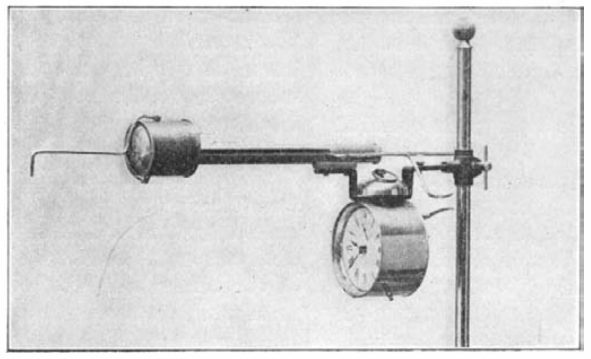
THE CHALLENGING YACHT "INGOMAR."

Although there is to be no race for the America cup this year, there will be a certain amount of international flavor imparted to the season's yachting by the fact that the crack American schooner yacht, "Ingomar," of which we show an excellent illustration, is now on her way to European waters, to sail in as many contests as she may find it practicable to enter. The special object of her trip, however, is to win, if possible, the celebrated New York Yacht Club's Cape May challenge cup, which has been held in England for nearly twenty years, having been won by Sir Richard Sutton's cutter "Genesta" in 1885. The "Genesta," it will be remembered, was the challenger in that year for the America cup, for which she made a brilliant struggle, being defeated by the centerboard sloop "Puritan." It was at the close of these races that the owner of the "Genesta" challenged for the Cape May cup. The defense of the cup was undertaken by the late Caldwell H. Colt's big schooner yacht "Dauntless," and the race took place outside Long Island, where it was sailed in a strong gale and a very heavy sea, in which the cutter completely outsailed the schooner. Only one attempt has been made since the cup went to England to recover it, and this was by the centerboard sloop "Navaho," which was built by Herreshoff for the express purpose. The Prince of Wales' cutter "Britannia" was selected for the defense, and she had no difficulty in defeating the centerboard yacht. The "Navaho," however, was one of the least successful of Herreshoff's boats. She represented his first attempt to build a large racing craft, and compared with his latest successes, she must be regarded as something of a failure.

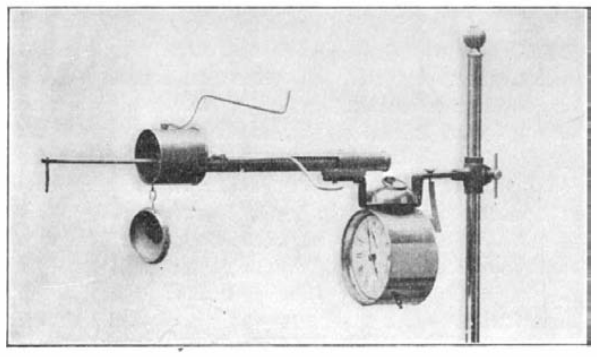
The beautiful craft which is now on her way to Southampton, however, represents the latest effort of the Bristol designer, and in her few races last season on the Sound, she proved to be a very able craft, easily defeating the competing yachts in light to moderate breezes, but being beaten by the Fife cutter "Isolde" in a heavy breeze. She is not such an out-and-out racing craft as the "Reliance" or "Columbia," although her construction is probably fully as light as that of such boats as the "Vigilant" and "Colonia." Her dimensions are: Length on the waterline, 87 feet; length on deck, 127 feet; beam, 24 feet; and draft, about 16½ feet. The boat was designed for racing in American waters, and originally carried a centerboard and a very large sail-spread. For her career in European waters she was altered by the removal of the centerboard and by the bolting of the lead ballast, that was formerly inside the hull, to the bottom of the keel. This increased the draft by about 18 inches and, of course, improved the stability on a given displacement. The changes in the sail plan consisted of an all-round shortening of the spars, several feet being taken from the main boom, and the mast being reduced about 7 feet. In her altered conditions she will be better suited to the strong winds and rough water of the English coast. The "Ingomar" will find herself in British waters at a very opportune time for the capture of the cup, inasmuch as there is no thoroughly modern craft in those waters to meet her. The cutter "Kariad," a Watson boat, about four years old, might sail against her, or the yawl "Sybarita," which is a year or two older than the "Kariad." A new schooner is being built and designed by Fife, which will be about 20 feet shorter on the waterline than "Ingomar;" but it is not likely that she can save her time allowance against a boat so much larger. At the same time there are some of the older schooners that are fast in a blow, and if there should be some strong winds and choppy seas during the contests, the "Ingomar" may find the competition keen enough to provide some very enjoyable sport. The probabilities are that she will win the cup, which is the chief object of her quest. She has the great advantage of being sailed by Capt. Barr, who will find himself in waters with which he is perfectly familiar, and in which he learned the art that has brought him into such world-wide prominence.



Apparatus Complete, with Exception of Hood, Showing Match in Place Above Scratching Plate.



Match Lighter Set, with Cap on Hood, Ready to be Released by Alarm Clock.



Match Thrust Forward on End of Rod, After Latter Has Been Released.

AN INGENIOUS AUTOMATIC DEVICE FOR LIGHTING A FIRE.

AUTOMATIC MATCH LIGHTER OPERATED BY ALARM CLOCK.

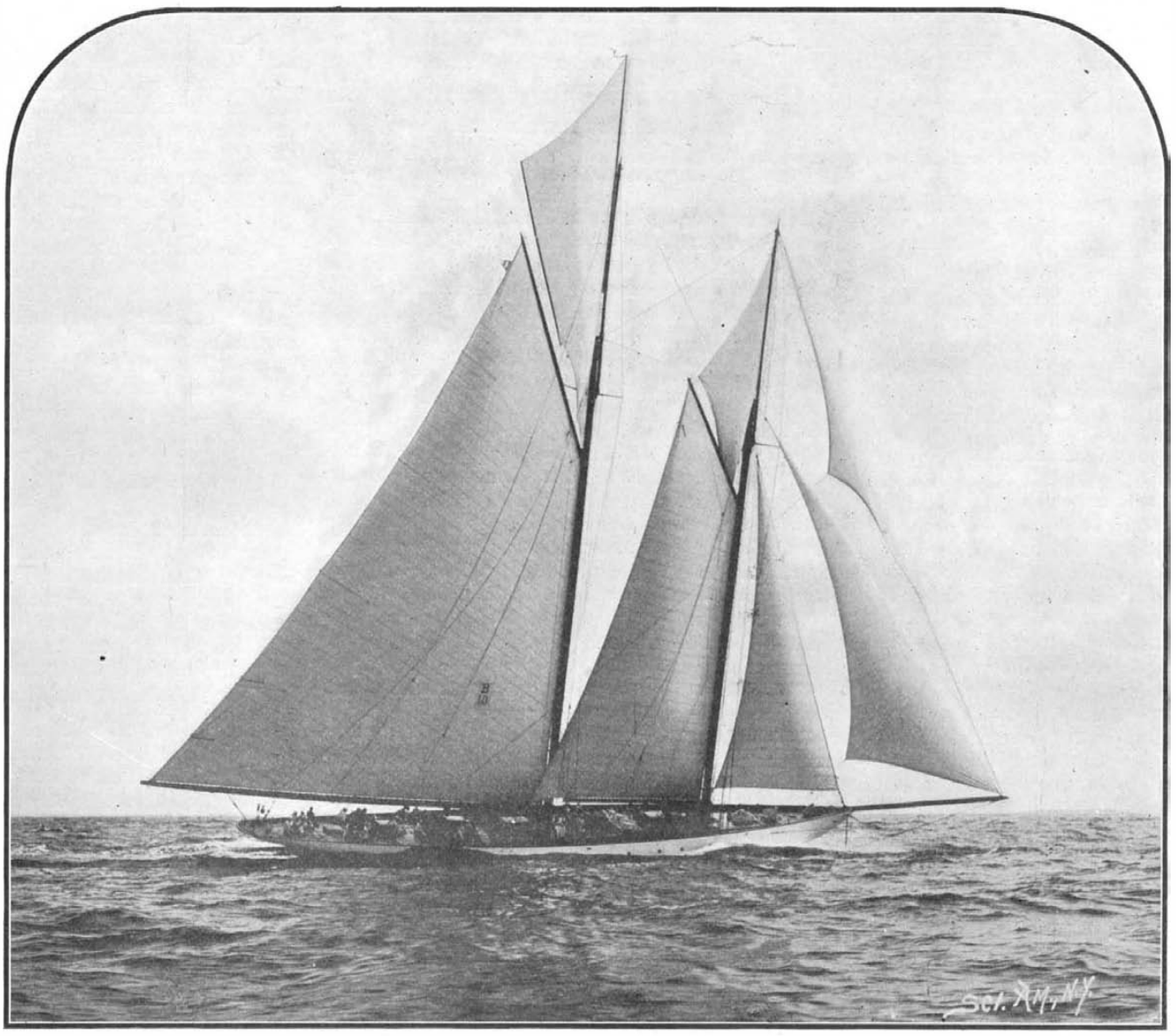
The automatic match lighter shown in the accompanying illustrations is the invention of Mr. E. Max Gotterman, of Melbourne, Australia; and it is an exceedingly simple yet ingenious apparatus, capable of being put to various uses. The apparatus consists of a mechanical arrangement for lighting a match at any desired time, the releasing of the match-moving mechanism being accomplished by an ordinary alarm clock. For this purpose, the alarm-winding thumb-piece is enlarged so as to form a lever that will strike and release a catch which in turn releases a coiled spring that suddenly pushes a match-holder over a piece of sand-paper, thus lighting the match. The lighted match is thrust beneath the grate of a stove, and lights the fire. It can also be made to light a candle, a lamp, or a gas stove, in the same manner.

The whole arrangement, as shown, is mounted on a bracket that slides on a vertical rod extending upward from a pedestal, and the bracket can be clamped at any desired position on this rod.

The small lever attached to the alarm-winding thumb-key of the clock is curved so as to strike the curved releasing catch, as seen in the illustrations. A regulatable stop screw is arranged on the bracket and can be set to stop the curved thumb-key lever after it has struck the releasing catch. The releasing catch is simply a curved wire fastened in a central pin that is contained in a sleeve within the center cylinder. Both sleeve and cylinder are slotted so as to allow the curved wire releasing catch to slide forward with the central pin, when the former has been pushed out of a notch at the rear end of the slots by means of the lever on the clock.

Outside of the central pin, which slides in a sleeve, and between this sleeve and the outer casing, is a strong coiled spring which presses against the curved wire releasing catch, and through it, pushes the central rod ahead when the catch releases.

A spring bumper is placed within the cylindrical case, at its forward end, for the purpose of cushioning the central pin and stopping it without an extremely sudden jar, which might extinguish the match.



Length on waterline, 87 feet; Length on deck, 127 feet; Beam, 24 feet; Draft, 16½ feet.

YACHT "INGOMAR," CHALLENGER FOR THE CAPE MAY CUP, NOW HELD IN ENGLAND.

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The central pin passes through a bearing in its sleeve, and through a hole forming another bearing in the end of the cylinder. In its outer end are two or three holes for matches. The match-scratching plate is placed horizontally at the end of the cylinder, and is mounted on a small coiled spring that keeps it at the proper height for the head of the match to rub over it when the central pin carrying the match is shot forward. The rim around the plate is notched and the plate is slightly inclined in order that the match may strike and rub over it without breaking. Furthermore, a little support keeps the match from falling when it is in position, ready to be lit.

The front end of the cylinder, and the parts attached to it, are inclosed in a cylindrical box or casing provided with an opening for the passage of the central rod and attached by a bayonet joint. This box is closed by a cover which is retained in place by a long bent wire, and attached to the box by a short chain. The blow of the central rod that holds the match, unlatches the cover and knocks it off. It was found necessary to protect the match from dampness, and hence this box was constructed to cover it.

To set the apparatus, it is only necessary to set the alarm of the clock at the desired hour, place a match in the end of the central rod, and push this into the cylinder as far as it will go, so as to engage the curved wire that holds it, in the notch at the end of the long slot in the cylinder. The cap is then placed on the box at the front end, and the apparatus is ready to work.

This device is evidently capable of various applications for industrial, as well as for household, use. It can be employed in all cases in which a lamp or a fire must be lit at a certain time. An automatic apparatus like this dispenses with a good deal of attention and of incommodious, as well as expensive, hand work. We will not cite all its uses, as the reader can easily comprehend them, and will doubtless think of some to which it has not yet been applied.

Manufacturing Boats for the War Department.

The United States War Department recently placed an order with the Electric Launch Company, of Bayonne, N. J., for one hundred and twenty large wooden boats or launches, which are to be used for laying submarine mines. The specifications call for 20-foot boats equipped with eight oars and extra heavily built to carry the mines, a pair of which will be stored on each boat. A roller at the stern will facilitate lowering the mines into the water. These boats will be carried on torpedo cruisers, each vessel being equipped with thirty of the launches.

Owing to the fact that the order calls for so many boats, all exactly alike, the Electric Launch Company decided to build one boat as a model, and then construct the rest in quantity from templates fashioned after the model boat. This process of manufacturing instead of building the launches is something new in the construction of boats. Ordinarily, every boat has its own individuality, and seldom are two built exactly alike. Occasionally a dozen or more may be built after the same pattern, but as far as we can ascertain, never before have conditions arisen which would make it profitable to manufacture boats. At Bayonne the mine-laying boats are being manufactured in two lots. The model boat has already been built, and templates have been formed of each part. These parts are now being reproduced in rough form, sixty at a time. Each rough form is clamped to the proper template, and brought into contact with a rotating cutter or forming tool, which cuts it to exact shape and size in a few seconds. This process results in a great saving of time, particularly in shaping odd parts, such as stern posts and stem pieces.

Facts About the Luminous Phenomena Due to Ozone and Radium.

F. Richarz and R. Schenck some time ago communicated to the Berlin Academy of Sciences the observation that sidoblende (zinc sulphide) becomes luminescent in a stream of ozone. In a paper recently read before the same academy, the experimenters record some other cases of luminescence due to ozone. While white phosphorus, as is known, will glow even in air, red phosphorus shows a luminescence only in ozone, this luminescence being of a slight intensity in the case of ordinary red phosphorus, while that of phosphorus derived from a phosphorus tribromide solution is very strong. As regards the disozonizing effect of sidoblende and red phosphorus, a stream of ozone which, having been left to itself, was not capable of acting on a steam jet, would act strongly after coming in contact with either of these substances. Among other substances showing a slight incandescence in ozone, there is vitreous arsenic acid, while a drop of turpentine oil shows a strong luminescence. The experimenters even happened to note that a finger held in a stream of strongly ozonized oxygen escaping into the air, as well as wool, paper, linen, or cotton, would show a luminescence, due most likely to the adherence of ozone to such bodies as smell of ozone, even after half a day or a whole day. As regards the question whether the luminescence is due to the substances themselves being oxidized by ozone or to the O-ions being freed by the disaggregation of the ozone, the authors intend making spectroscopic investigations to determine.

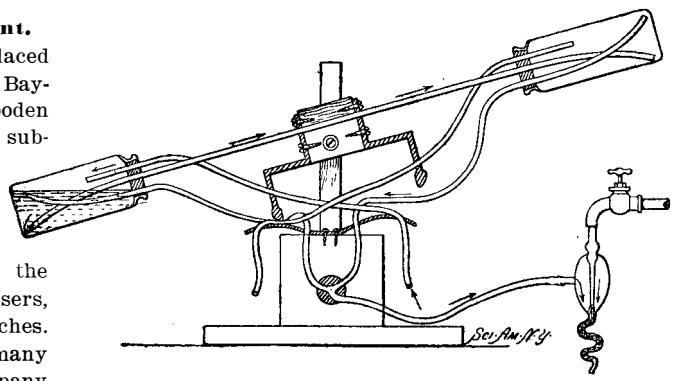
AN IMPROVED MICHAUD APPARATUS.

BY J. FID. TRISTAN.

Here is a little apparatus which, like Mariotte's bottle, can be used with success to demonstrate many laws. It can be made in a short time with ordinary laboratory implements, and has proved very useful in my class.

Two bottles are employed, each provided with two flexible tubes, one serving to admit, and the other to exhaust air from the bottle. The bottles are connected by a main glass tube which is bent down at each end in the bottle as shown. This tube is mounted at the center in a wooden block pivoted between two arms of a standard. Two pieces of brass depend from this block and, as the apparatus oscillates, are adapted alternately to close certain of the flexible tubes by compressing them against a metal plate on the standard. The exhaust tubes of the bottles are connected to an aspirator, and one of the bottles is partly filled with water so as to tilt the apparatus to the position shown. In this position it will be observed that the exhaust tube of the lower bottle and the inlet tube of the upper bottle are both closed. Now, when water is turned on in the aspirator, a vacuum is produced in the upper bottle, and as the inlet tube of the lower bottle is free, water rises rapidly through the glass tube to the upper bottle. As this bottle slowly fills, it overbalances the other bottle and swings down to the lower position. The conditions are now reversed, and the same operations are repeated on the other side. About fifteen oscillations per minute are thus obtained.

The principle of this apparatus was first made



AN IMPROVED MICHAUD APPARATUS.

known by Dr. Gustave Michaud in the Scientific American of December 16, 1893. The apparatus illustrated is an improvement on Dr. Michaud's device, and is so modified as to provide a longer duration of oscillations.

Results of Experiments With Westrumite for Laying the Dust on Highways.

Some experiments were recently made in France with a mixture of various oils, tar, etc., called "Westrumite," on 3.1 miles of national road between Nice and Monaco. The road was carefully swept one evening and was thoroughly sprinkled the next morning with 5 and 10 per cent solutions of westrumite. With street sprinklers containing 1,000 liters (264.2 gallons) of water to which had been added 100 or 50 liters (26.42 or 13.21 gallons) of the product, 1,000 square meters (10,764 square feet) were covered. After two or three hours, the road was sufficiently dry for traffic to be resumed. This was especially the case if the road was sprinkled at night, which was preferable. The next day the same sections of road were sprinkled anew with the same solutions, so as to obtain a better penetration of the product. Ten days after these sprinklings, in spite of a summer sun, a great deal of wind, and a very considerable automobile and horse traffic, the dust had completely disappeared on those parts of the road which had been sprinkled twice with 10 per cent solutions, while the results obtained from two sprinklings with 5 per cent solutions lasted only four or five days.

No harm was done to the garments of travelers, to pneumatic tires, or to the varnish of fine carriages. The Westrumite soaks into the road to a depth of from 3 to 5 centimeters (1.18 to 1.96 inches) and becomes incorporated with it. Torrents of rain which fell during two days did not wash it off the road, as the volatile substances which make it soluble in water evaporate when it first dries, whereupon it becomes insoluble and can no longer be washed off by rain water. The formation of mud by the latter is considerably diminished, and the good results appear to last quite a while. Subsequent sprinkling solutions need contain only 2 per cent of Westrumite. Instead of sprinkling the road every day with the water, it only requires sprinkling once in two weeks with a 2 per cent solution of Westrumite. A kilometer (6-10 of a mile) of road 6 meters (19.68 feet) wide can be sprinkled for about $60 for the first two times and certainly for not more than $40 for the balance of the year; so that it costs in the neighborhood of $100 a kilometer, or $165 a mile, to keep a road free from dust the whole year round.

Automobile Notes.

The annual hill-climbing test held last month at Boston by the Massachusetts Automobile Club resulted in a tie between a 40-horse-power Richard-Brazier machine and a 60-horse-power Mercedes. Both cars covered the fifth of a mile hill in 15 2-5 seconds, thus reducing the previous record of 43 1-5 seconds by about 60 per cent. In the steam vehicle class, a Stanley steam carriage lowered its previous record of 17 seconds by 2-5 of a second, while the old electric-vehicle record of 76 3-5 was reduced one second.

Arrangements have not as yet been completed for the 300-mile race for the cup given by Mr. William K. Vanderbilt, Jr. Joseph Tracy, on a Peerless racer, ran over the proposed course on Long Island recently, and he reports the roads in fine condition. It is probable that the race will be run over them some time this summer, if the necessary permission can be obtained. In connection with this race, one of the automobile papers suggests that it be run on two days, the light cars being raced the first day, and the heavy ones the second. This would allow more vehicles to compete, and only the same class of vehicles would be placed in direct competition, while the race would be won just the same by the car that made the best time.

Two inventions that are destined to be of great value in improving gasoline motors of both the water and air-cooled types have lately been made. One is a method of electrolytically depositing a copper water jacket around a cylinder, while the other is a process of casting steel and copper heat-radiating flanges integrally with the cylinder, and thereby obtaining a much more efficient radiation. In carrying out the first process, the outside of the cylinder is electro-plated with copper. The plating of copper is then covered with the proper thickness of wax (which has been treated so that it is a conductor) and a complete jacket is electroplated over the wax, which is then melted out, leaving a thin, integral, copper water jacket capable of withstanding a pressure of 30 pounds per square inch, and which is 60 per cent higher than the usual cast jacket.

What will unquestionably be the greatest automobile event of the year in this country is the run to the St. Louis Exposition, which is planned for the latter part of July. The New York division of tourists will start about the 25th of the month, and will have the choice of two routes—one through the Catskill Mountains and across New York State to Buffalo, whence they will proceed to Chicago, and then travel south to St. Louis, and the other *via* Philadelphia and across southern Pennsylvania in a direct line west to St. Louis. New England automobilists will start from Boston, and, traveling *via* Albany and along the line of the New York Central Railroad to Buffalo, will join the New Yorkers at that point. The intention is to have motorists from all parts of the country make a triumphal entry into St. Louis on the same day, which will probably be Thursday, August 11. The various routes are all being investigated, and full information concerning them will soon be obtainable from the American Motor Association. That through the Catskills and across New York State, which was traversed last fall successfully by so many American cars, under the severest weather conditions that could possibly obtain, should be a picturesque and easy route in midsummer, capable of being run over by any well-built and medium-powered car. From Cleveland to Chicago and south to St. Louis, the roads are mostly of the good gravel or dirt variety. There are numerous short, sharp grades of not exceeding 15 per cent, but nothing that should offer insurmountable difficulties. The route directly west through Pennsylvania, though a straighter and shorter one to the fair, is much more hilly, and the roads are not so good. There is a good deal of picturesque mountain scenery, however, to be enjoyed on a trip to St. Louis by this route.

A return has been issued by the Admiralty, giving the results of prize firing in the fleet during 1903, in which their lordships note with satisfaction the improvement in shooting with nearly all classes of guns. The award of medals, it is announced, will be promulgated shortly. Among the battleships, the "Majestic," flagship of the Channel squadron, heads the list, the "Albion" and "Goliath," of the China squadron, being second and third respectively. The "Benbow," of the home squadron, is thirty-second, and last of the list, her barbette guns actually scoring no points whatever. Among the cruisers, the "Good Hope," of the cruiser squadron, was first; the "Charybdis," of the North American squadron, second; and the "Flora," of the Pacific, third.

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Correspondence.

Bird Soaring.

To the Editor of the SCIENTIFIC AMERICAN:

I very much question the conclusions of Mr. Garrett P. Serviss in explanation of the soaring or floating of birds, given in his interesting paper on the subject in the SCIENTIFIC AMERICAN of April 30.

I am inclined to think that the following three statements can be substantiated by close observation:

First: The sailing without motion of the wings is usually in circles, and often at times when the air is comparatively still.

Second: At times the bird is constantly falling, but in such gentle spirals as not to be detected by the eye except after long observation.

Third: That often the bird is not falling; and invariably when it is not, the head is lightly raised and the tail depressed, and thus the bird is borne upward, or kept on a level by the pressure of the air current underneath, caused by its rapid flight. And in order to regain its momentum, which it is constantly losing by reason of the resistance of the air underneath, at intervals, and sometimes at very long intervals, the wings are flapped a few times, and then are again in repose.

Such, at least, are my conclusions in observing the flight of the common buzzard, the only bird whose soaring I have had an opportunity of seeing.

Paris, Ill., May 3, 1904. HENRY F. NELSON.

Gravity.

To the Editor of the SCIENTIFIC AMERICAN:

If the attraction which we call gravity is independent of (not a function of) time and space, then I would submit that the law of the inverse square follows directly.

Consider the attraction of a particle. Call the particle A, and let it be the center of a sphere. Let this sphere have any radius x.

If the attraction of A is independent of time and space, then always the attraction of A on the surface of the sphere is exactly the same whatever the radius x of the sphere.

Now the extent of the surface of the sphere varies *directly* as the square of the radius.

It follows then that the attraction of A on any other particle on the surface of any such sphere must vary *inversely* as the square of the distance.

A rough proof of the above (for the schoolroom) may be given thus: Assume the surface of any such sphere to consist of particles. Now the sum of the attraction of A on such particles is always the same. But the number of such particles varies directly as the square of radius of the sphere. In order then that the attraction of A should be always the same, this attraction of A on any particular particle must vary inversely as the square of the radius, that is the attraction of A on any exterior particle must vary inversely as the square of the distance.

F. C. CONSTABLE, M.A. Trinity College, Cambridge.
Wick Court, near Bristol, England.

Double-Deck Cars.

To the Editor of the SCIENTIFIC AMERICAN:

In your issue of April 2, 1904, I notice a communication from C. P. Carpenter, of Northfield, Minn., relating to double-deck cars for rapid transit in San Diego. For the benefit of the readers of the SCIENTIFIC AMERICAN, and to set Mr. Carpenter right, a little explanation seems necessary.

Double-deck cars were first put on the street-car lines of San Diego in September, 1892, and they were taken off in July, 1903. The cars were 26 feet over all, single trucks, and the seating capacity was 24 on the lower floor and 24 on the upper deck, with one seat each in the front and rear of the car running crosswise. The lower floor and the upper deck seats ran lengthwise; the upper deck seats were built back to back, not crosswise, as Mr. Carpenter's communication to the SCIENTIFIC AMERICAN would have it.

There were only two cars on the lines, and they were Nos. 1 and 2 respectively. They have been dismantled, and they will not, as I understand it, be put on the road again.

The double-deck car may, however, be seen across the bay at Coronado. These cars are longer than the ones that were in use in San Diego, being 36 feet over all and seating 40 people on the lower floor and the same number of people on the upper deck, with two seats both in front and rear of the car running crosswise; they had double trucks. These cars certainly are a delight to the eastern tourists, who eagerly climb to the top in order to get a better view of the magnificent surroundings. I am indebted to Mr. Perrin, assistant superintendent of transportation of the San Diego and Coronado lines, who kindly furnished me with the dimensions, seating capacity, etc., of the cars.

San Diego, Cal. JOHN B. BOUR.

THE TORPEDO BOAT IN MODERN WARFARE.

If there have been any doubts as to the utility of the torpedo boat under modern conditions of naval warfare, they have been completely dispelled by the activity of the torpedo-boat flotillas of both contestants in the present war. In the first place it is to her torpedo-boat destroyers that Japan is indebted for that command of the sea which has given her such pronounced advantage in the present series of operations. The crippling of the Port Arthur fleet was essentially the character of work for which the torpedo-boat destroyer was designed, namely, a swift dash under the cover of darkness among the ships of the enemy, the discharge of torpedoes at a range sufficiently close to make their finding the mark a practical certainty, and an instant retreat at full speed beyond the range of the searchlight and the rapid-fire gun. The terrible blow that was struck proves that the torpedo-boat destroyer is about the right kind of craft for such work; although it could be wished that the test had been rendered more severe by the ships being guarded by torpedo nets, the guns shotted, and the gun detachments fully prepared to repel attack, conditions which, it seems probable from the evidence at hand, did not exist.

The war has proved the wisdom of building torpedo-boat destroyers of the dimensions and power that characterize the latest models. With their length of 220 feet, beam of over 20 feet and draft of between 9 and 10 feet, giving a displacement of between 300 and 400 tons, the modern destroyer is a very serviceable sea boat, which was more than could be said for the torpedo boat of an earlier decade. The high freeboard and the provision of a raised turtle-back forward, render these boats able to maintain their high speed in fairly rough water, and in the present operations the flotillas of Japanese destroyers seem to have been perfectly well able to keep the sea in all weather. Evidently the lessons taught by the disasters that happened to some of the high-powered British torpedo-boat destroyers, when they were badly wrenched, and in one case actually broken in two in a heavy seaway, have been laid to heart, and the Japanese destroyers which are now doing such good work around Port Arthur are evidently seaworthy vessels.

A surprising feature of torpedo-boat service in the present struggle is the wide range of duties which are assigned to the destroyers. Scouting work which ordinarily would be given to cruisers from 3,000 to 6,000 tons displacement seems to be satisfactorily carried out by these little 400-ton craft. Moreover, their small size and swift movement apparently render it safe for them to steam saucily right in under the heavy batteries of Port Arthur; for on every occasion in which "fire-ships" and stone-laden steamers have been sent in for the purpose of corking up the harbor entrance, they have been escorted by a certain number of destroyers.

We think it is likely that one result of the experience gained in the present conflict will be an increase in the armament of the destroyer, for the rapid-fire guns carried by both the Russian and Japanese vessels have decided the fate of more than one hard-fought battle between these craft and have sent several of them to the bottom. In each case the defeat of the Russians was attributed to the inferiority of their armament, the Russian craft carrying one 12-pounder and five 3-pounders as against one 12-pounder and five 6-pounders mounted on the Japanese destroyers. It will not be surprising if there is a tendency to increase the armament of future destroyers, and if this is done it will introduce a problem that will tax the ingenuity of designers severely, for the extra guns added will mean an increase in the size of the vessel, and fine lines and great engine power are elements that can never be sacrificed. On the other hand, the British have made a striking departure by cutting the speed down from 30 and 31 knots to 25 and 26 knots an hour, and increasing the displacement from 350 to 550 tons. On boats of this size it would be possible to carry a much heavier armament, if desired, and it is not unlikely that we shall see destroyers of 600 tons displacement carrying four 12-pounders and half a dozen 6-pounders.

By reference to the sectional diagram on our front page the reader can obtain a very complete idea of a torpedo-boat interior. Forward in the bow is a collision compartment formed by a bulkhead located several feet from the bow. Aft of that is the chain locker, and then the torpedoes, of which half a dozen are carried on a vessel of this character. Since the torpedo boat carries no armor whatever, the torpedoes, the war-heads, and the magazines are placed below the waterline, where they are safe from any except a plunging shot. The torpedoes are stowed with their war-heads containing the gun-cotton charge unscrewed, the latter being stowed separately, as shown in the engraving. Aft of the war-heads is the forward magazine and a compartment given up to the general ship's stores. On the deck above are the quarters for the crew, which will number between fifty and sixty men in the larger boats.

Fully one-half of the boat is taken up by the motive power, which, of course, is out of all proportion to the size of the craft, these little vessels, which are not much over 200 feet in length, having, some of them, as much horse-power as a large ocean-going steamer. The average horse-power of a first-class torpedo boat is 7,500, and to secure this, high steam pressures and great speed of revolution are, of course, necessary. In our illustration there is shown an athwartship coal bunker, and other coal bunkers extend on each side of the vessel in the wake of the boiler space, the coal serving to give some measure of protection to the vitals. The boilers are of the water-tube type and are capable of delivering enormous volumes of steam on a minimum of weight. Aft of the boiler space is the engine room, where the twin engines are arranged, one forward of the other, each on its own shaft. Then follow the space devoted to auxiliary engines, the gangway beneath which is another magazine, and aft of this the officers' wardroom, below which is a space devoted to general stores. The extreme after end of the boat is taken up by the warrant officers' messroom, back of which may be the bread room or apartments given up to ship's stores.

Two torpedo tubes are shown mounted on the main deck. These are capable of discharging torpedoes through a wide arc of training on either beam. The torpedoes are brought up from the racks in which they are carried by means of slings which roll up the sloping table shown in the engraving. When they reach the deck the war-heads are screwed on, and they are placed on a little trolley which travels upon rails laid on the main deck, by which they are run to the torpedo tubes and loaded through the breech, in much the same way as a projectile is loaded into a breech-loading rifle. The firing is done by means of a small charge of powder, the gases of which serve to compress a certain volume of air which expels the torpedo, the air acting as a cushion to give the torpedo a more gradual acceleration and avoid the shock which would occur if the powder acted directly upon it. The maximum firing range that it is considered desirable to use to-day with the latest improved torpedoes is about 800 yards. Of course, good shooting could be made at longer ranges; but ordinarily the captain of the destroyer will prefer to get into a range of 800 yards or less, being willing to take the greater risk for the sake of the greater certainty of hitting the mark.

Greth's Eight-Mile Airship Trip.

Dr. August Greth's airship, which has been fully described and illustrated in these columns, made a fairly successful trip on May 2, near San Francisco.

The breaking of a small valve prevented Dr. August Greth sailing from San Francisco to San José, a distance of fifty-two miles. As it was he crossed the San Mateo County line, 8 miles south of San Francisco, and anchored on a hill, ready to renew the attempt. He went up at 8.30 A. M., accompanied by an engineer.

Dr. Greth made a circular turn about a quarter of a mile in circumference. Everything went well until the airship arrived over the Five Mile House, on the San Bruno Road. The inventor and the engineer were seen trying to adjust the machinery, and then, after a pause, the fans were started going and the ship began to descend.

To all appearances the fans were able to control the ship, though it was conceded that they were not quite large and powerful enough to meet the resistance of strong winds. The airship came down gradually and touched the ground gently, allowing the men in the car to step out. Nothing was injured either in the car or about the great gas bag.

The Current Supplement.

One of the greatest attractions at the last Parisian automobile show was undoubtedly the Renard continuously-propelled automobile train. Mr. Emile Guarini opens the current SUPPLEMENT, No. 1480, with a well-illustrated and complete account of this new departure in automobile engineering. Thomas A. Edison tells something of the beginnings of the incandescent lamp and shows what a vast amount of labor this invention of his involved. Mr. H. W. Harmon describes an electrically-registering wind-vane and anemometer for school use. An excellent article on thermit by Prof. C. V. Boys thoroughly discusses Dr. Goldschmidt's important invention. Striking pictures of the sunken vessels "Korietz" and "Variag," lost by the Russians in the battle off Chemulpo, are published. Elizabeth Mills-Stetson tells something of the skill and inventive ability of the aborigines of Southern California.

A World's Fair feature of general interest is the Japanese exhibit of diminutive trees, only two or three feet high although several hundred years old. This forest of little trees is a part of the attractive display of many interesting exhibits which Japan shows at the Fair.

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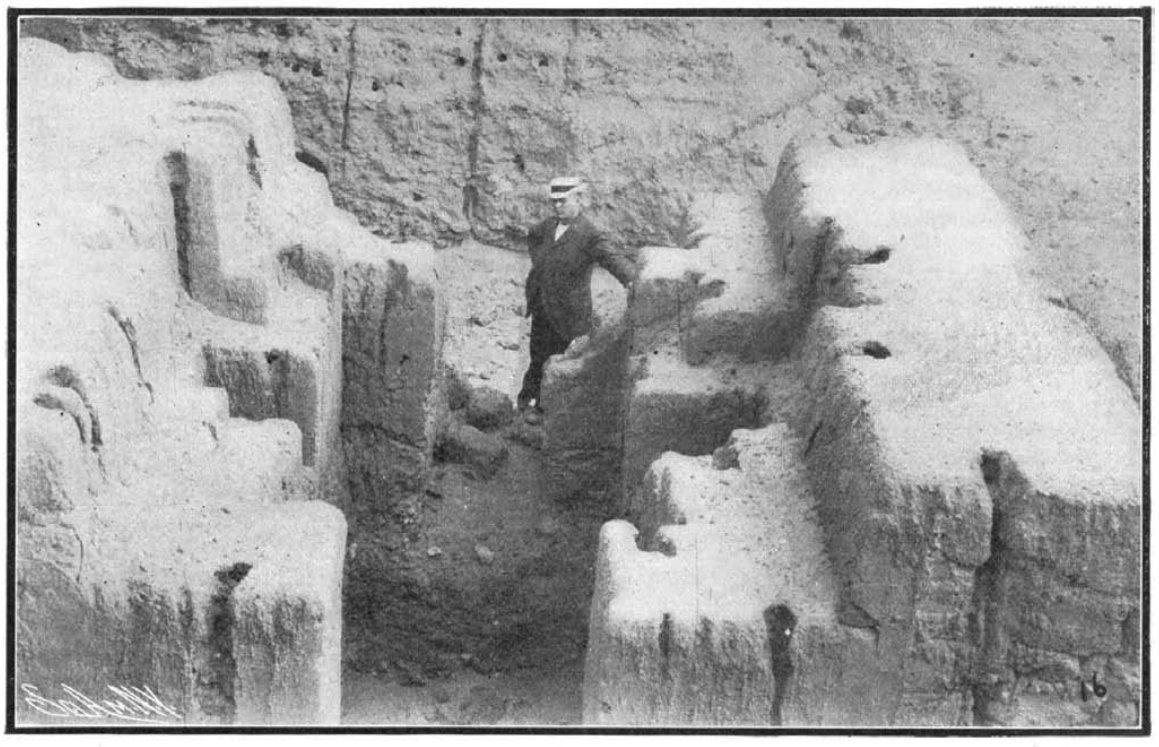
RUINS OF THE ANCIENT INCA EMPIRE.

BY WALTER L. BEASLEY.

The writer, in a recent article in these columns, presented a general pictorial array, accompanied with brief text, of some of the rich and artistic treasures which were obtained from ancient burial sites of the Inca empire in Peru and Bolivia by the Bandelier expedition, sent out under the auspices of the American Museum of Natural History. The inventive ingenuity and marvelous technique displayed in their pottery, fabrics, and in the fashioning of gold and silver ornaments ranks the ancient Incas as the most preeminent artisans of the New World. A glimpse is afforded in the present narrative of some of the existing architectural remains of this vanished and cultured Indian empire, together with some new studies by the explorer of the social and tribal organization of the Incas.

It is said that this tribe did not commence to be conquerors until they had first shown themselves to be statesmen and wise and efficient administrators. Having obtained a fairly advanced civilization, they began gradually to overawe and incorporate the territory of less cultured tribes of the coast and slopes of the Andes, who slowly absorbed both the religion and superior handicraft of their conquerors. These conquests extended over a period of several centuries. The permanent establishment of Inca power is attributed to their having secured the good graces of their new subjects, and to their liberal treatment and policy of conciliation, than to force of arms. This continued until the limits of Inca rule extended from the central plateau of Bolivia to the western coast of Peru, north to Ecuador, and south to northern Chile. The inhabitants of this territory embrace many different tribes with local rulers, living in different stages of enlightenment.



Altar in Heart of Artificial Mound, Ruins of Chan-Chan.

RUINS OF THE ANCIENT INCA EMPIRE.

Under Inca sway and influence, both architecture and the various industrial arts reached their highest degree of efficiency. Few, if any, countries of modern times have equaled the extreme and skillful utilization of land that was practised during the time the Inca empire flourished. In many localities they built their dwellings among rough rocks, on arid slopes of hills, in order to use the limited area of soil for agriculture. They terraced up every hill and mountainside until not a single spare foot of surface was left unimproved. They likewise constructed aqueducts for irrigation purposes, and also a series of magnificent roads, from twenty-five to fifty feet in width, paved with blocks of stone, which connected their royal capital at Cuzco with the various provinces. Part of the way these were cut out of solid stone, and often ascended precipitous heights by a series of stone stairways. Traces of these roads still exist in many localities.

The enthusiastic archæologist investigating the archæological ruins is somewhat handicapped by government restrictions, which limit the nature and extent of the excavations. The absence, also, of certain unobtainable data and chronicles of the Spanish historians, whose manuscripts, written just after the conquest, have either been ruthlessly destroyed during the various civil revolutions, or others equally as valuable still unpublished and said to be preserved among the archives of Madrid, has deprived the modern historian of much valuable information. Fortunately, however, notwithstanding the lapse of centuries and a deal of vandalism, there still remain several groups of interesting ruined structures, designated as palaces, temples, and great religious buildings. Nothing is left of these in most cases but a series of ornamented walls, those on the coast being profusely decorated with fresco work, which attest to a superior knowledge of the art of construction and ornamentation at this early period. The interiors of these buildings were lavishly adorned with furnishings of pure gold and silver, which supplied valuable loot to the Spanish conquerors. Mr. Bandelier examined and partially excavated, made measurements, and reconstructed ground plans of several of the important ruined sites within the zone of Inca territory.

One of the most noteworthy of the coast ruins investigated by Mr. Bandelier were those of Chan-Chan, commonly called Chimu, near the present city of Truxillo, four typical views of which are here reproduced. The ruins extend for a distance of three miles, and are one and a half miles in width. Nothing remains of the original appearance and former grandeur of the buildings except well-laid foundations, massive and peculiarly ornamented walls and groups of single-story, gable-roofed houses and courtyards. Mr. Bandelier estimates that some forty thousand persons occupied the place. The best ancient information of the Chan-Chan ruins and those in the immediate vicinity is to be derived from the early Spanish chronicler, Cieza de Leon, who visited this locality about a decade after the conquest, and is considered the most trustworthy authority. According to de Leon, this valley in pre-Spanish times was dominated by several powerful chiefs or lords, who waged warfare continually with near and distant tribes, and were feared and obeyed by their subjects. Each lord or ruler resided in a great city, the seat of his realm, which contained various imposing buildings. When these sovereigns were subdued by the Incas, still larger and more pretentious structures were erected. The architectural plan of Chan-Chan comprised a series of about twenty open squares of courtyards intersecting one another. On certain sides facing these were erected a number of palaces or religious edifices. Each square was surrounded by an exterior wall of adobe blocks, twenty-five feet in height. The larger buildings contained innumerable chambers and corridors, traversed by narrow passageways. Many treasures of gold and silver are said to have been found in these chambers and apartments. Around one of the great public squares were arranged some of the one-story adobe dwellings of the inhabitants. These are to-day graphically outlined, and preserve their original appearance, showing sharply-pitched gable roofs. There are no traces of windows. Light and ventilation seem to have been furnished by the door alone. It is supposed that some of the great squares and inclosures were occupied by the various craftsmen and industrial workers in pottery, weavers and dyers of fabrics, and fashioners of metal ornaments for the use of the ruler, his household, and his priests. One of the curiosities discovered by Mr. Bandelier was an altar some fifty feet below the surface, which formed the heart of a great artificial mound, and which evidently occupied the central place in a large building devoted to religious worship.

One of the noteworthy phases of the Chan-Chan ruins were the ornamented walls of two of its buildings, thought to have been devoted to sacred purposes, or to have served as the abode of the ruler. In one instance, a series of designs had been sunk a half-foot or more in the adobe over the entire wall, now seven feet high. Possibly these may have been apertures for hiding gold and other ceremonial offerings, and afterward sealed up by an additional adobe coating. Another façade, ten or more feet in height, is tastefully decorated with a network of frescoes in a series of duplicated designs of a conventionalized bird. These walls are surrounded by a mass of fallen debris; and nothing is left to throw any light upon their ancient splendor. Probably the most monumental and puzzling of all of the Inca ruins is the great pyramid on the banks of the Moche River. Sphinx-like, this majestic artificial mound rises upward in the air 150 feet, crowned by a series of terraces. It is 800 feet in length. The massive and imposing mound, reared by ancient builders, has marvelously defied time and vandalism, and still holds fast the secret of its creation, for it remains to-day a veritable enchanting riddle to the archæologist. No attempt has been made in recent times to excavate it. Tradition affirms that within lie buried fabulous treasures of gold, silver, and precious objects. In the sixteenth century a tunnel is said to have been made half-way to its center, and a large quantity of valuable ornaments obtained. This opening can still be penetrated, but no late investigator has attempted to push far within. Probably it was used as a religious shrine or sacrificial place, or on the other hand, from its lofty and commanding position, it may have been used as a strategic point to detect the approach of hostile invaders. The best-preserved architectural ruins, and those showing to striking advantage the extraordinary skill of the Incas in handling, polishing, and setting massive stone blocks, are the Chulpas or Burial towers. A celebrated and typical group is found at Sillistani, near Puna, built on a promontory 200 feet high. These peculiar and sumptuous sepulchers are termed by the late E. G. Squier, an authority on Peruvian culture, "The most elaborate and architecturally the most wonderful works of aboriginal Americans." The one here pictured is 25 feet high, 27 feet in circumference on the top, and 22 at the base. The majority are round; others are square in shape. In these, the bodies were interred with great pomp and ceremony, together with rich offerings of gold, silver, and choice pottery. The interiors of the Chulpas vary in size and construction; some have a single vaulted chamber, others two, arched over by stone. A few have niches. The entrance is gained through a small opening at the bottom, hardly large enough to admit the body of a man. This was closed by a stone slab.

That the coast Indians and Incas were a music-loving people is evidenced from numerous representations on pottery vessels of performers in the act of playing upon their instruments, as well as from the large number of actual instruments obtained. In their extensive religious worship and ceremonial dances music was a necessary feature, and was widely employed. Mr. Charles W. Mead, curator of the Peruvian Department of Archæology, in a recent monograph on this subject, states that he was unable to discover any authentic musical scale or song of the Incas, and the best and only source of information is to be gained from the structure and character of the instruments themselves. It is commonly believed that they employed the five-toned or penatonic scale, so widely used in the primitive music of ancient peoples. The most important of their instruments were the drum and pan-pipe. Both of these are modeled in the shape of water jars representing human forms, and give a clever idea of their construction and appearance. The drums appear to be identical with those in use in many parts of Peru to-day, and were made by stretching a skin over a hoop of wood.

The pan-pipe was a series of reeds of graduated length, held in position by a cross-piece of split cane lashed to the reed with a cord made from the wool of the llama. The present natives still dance to the beating of the drum and pan-pipe, as did their ancestors hundreds of years ago. Nearly fifty different instruments, all of percussion and wind, were found. Remarkably unique among these are many double whistling jars or musical water bottles. Near the top of the first or front jar, which was usually surmounted by a human or animal figure, is the opening of the whistle. When the jars have been partly filled and are swung backward and forward, a number of whistling sounds are produced. As the vessel swings forward and upward, the water is lowered in the first jar and raised in the other. In the backward motion it rushes back into the first, forcing the air out through the whistle. One of the new musical discoveries heretofore unknown, and worked out by Mr. Mead, is the fact that shells were employed as cymbals. This is conclusively established by a terra-cotta water vessel, which is covered, showing the figure of a man in the act of striking two shells as cymbals.

Lake Titicaca.—On the islands of this lake is located the traditional birthplace of the Inca tribe, and here were built several large and imposing structures, the ruins of which still exist. Not far distant was located Cuzco, the chief settlement. The population of Cuzco and the valley in which it is situated, according to Mr. Bandelier, is said to have numbered between sixty and seventy thousand. The language spoken was, and is now, Quicha. The whole place was built around courtyards or squares, and contained

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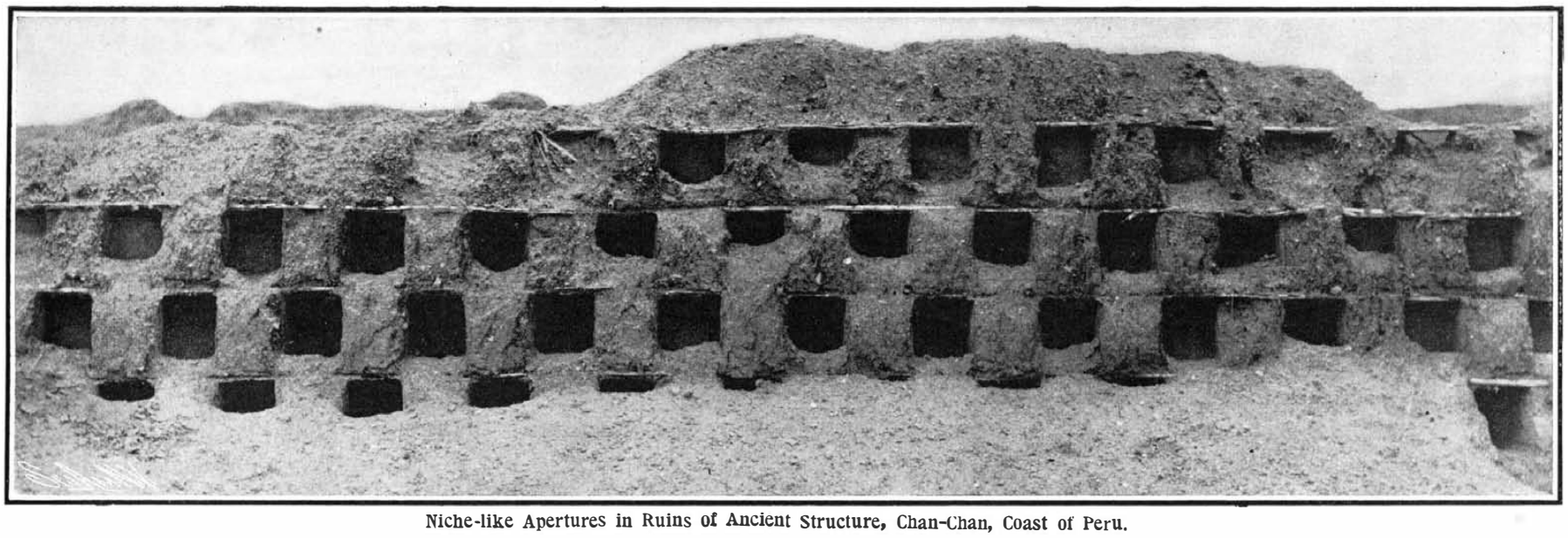
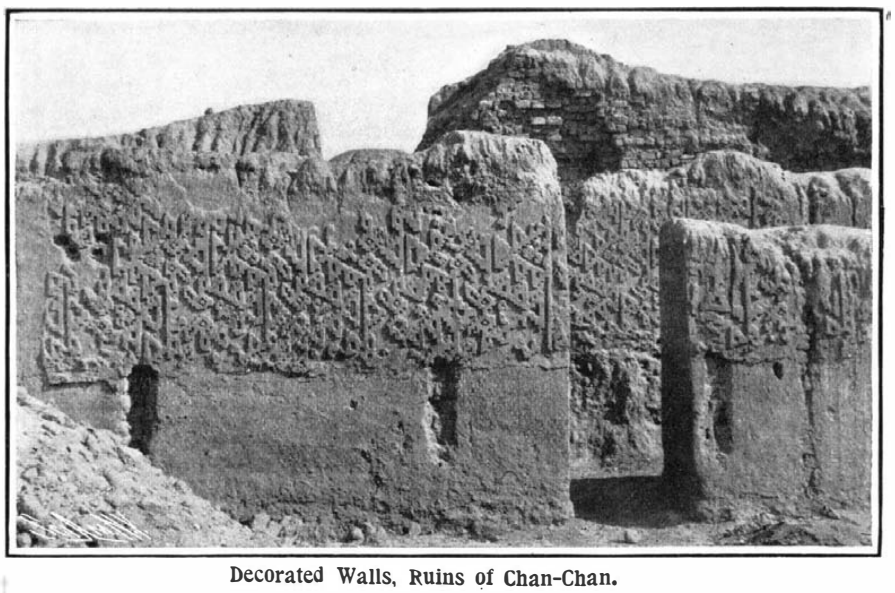
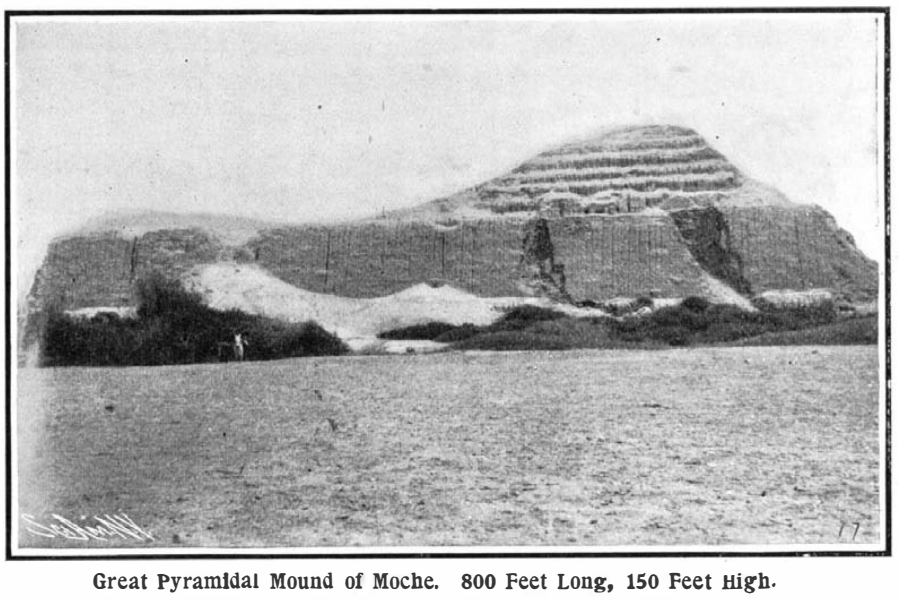


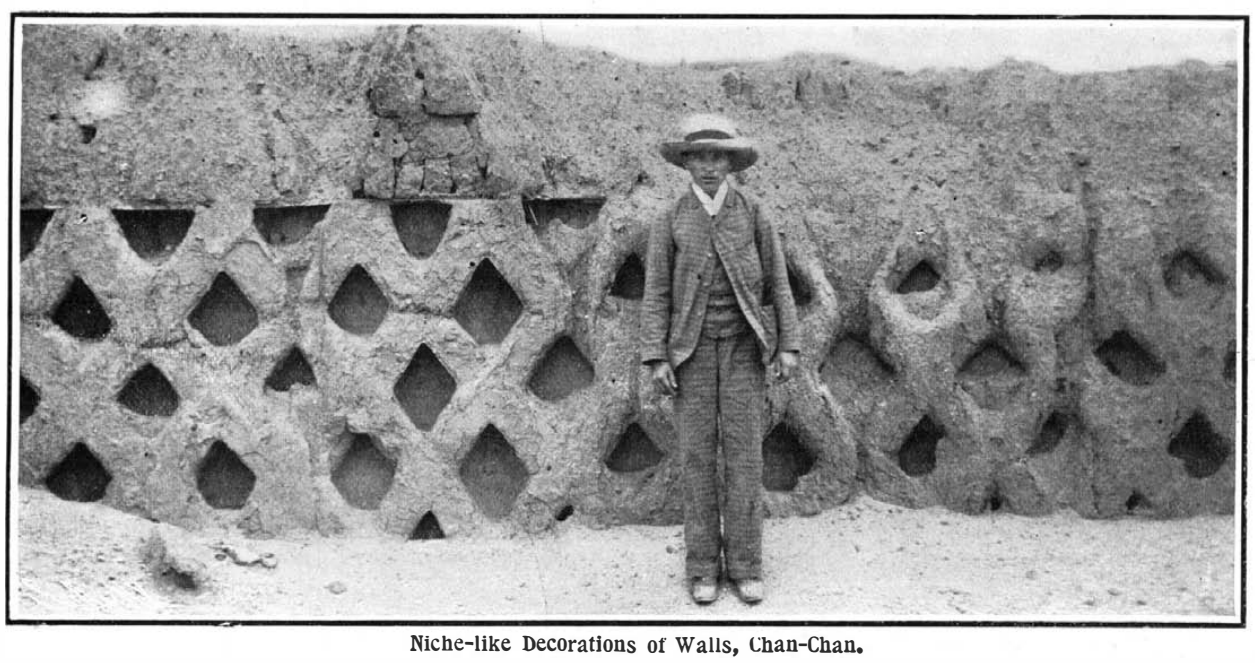
Niche-like Apertures in Ruins of Ancient Structure, Chan-Chan, Coast of Peru.



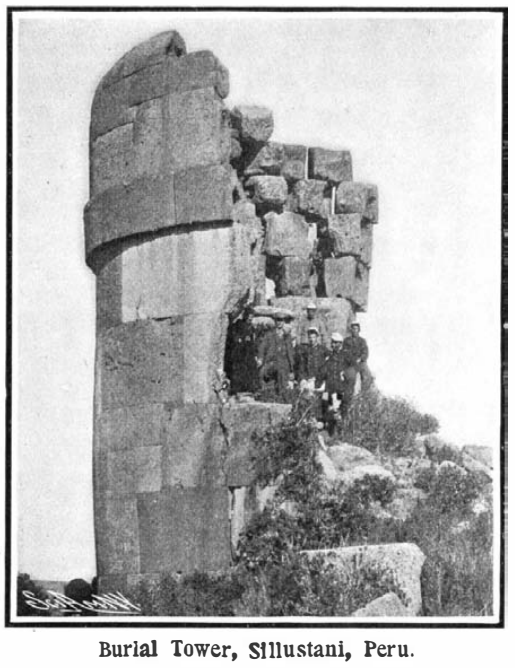
Decorated Walls, Ruins of Chan-Chan.



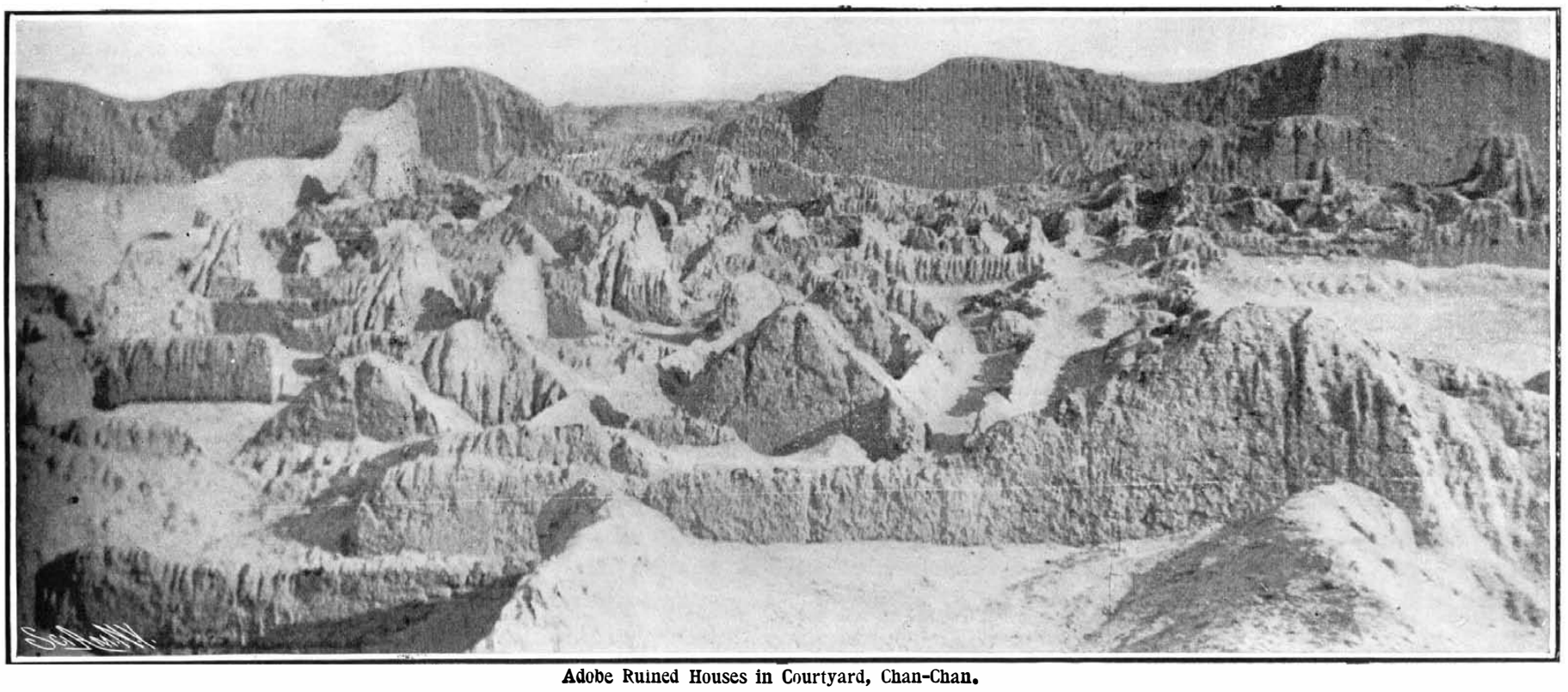
Great Pyramidal Mound of Moche. 800 Feet Long, 150 Feet High.



Niche-like Decorations of Walls, Chan-Chan.



Burial Tower, Sillustani, Peru.



Adobe Ruined Houses in Courtyard, Chan-Chan.

RUINS OF THE ANCIENT INCA EMPIRE.

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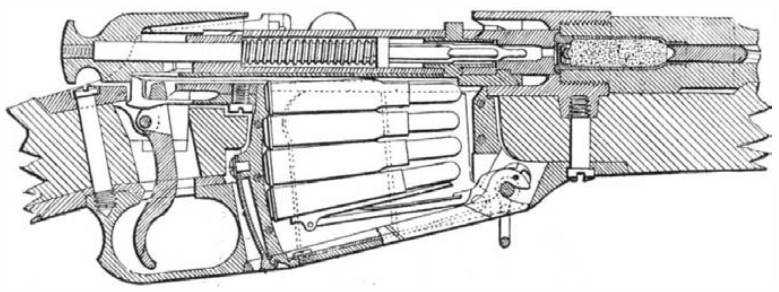
spacious buildings, constructed partly of huge, well-cut stones. The roofs, however, were of thatch. Some of the stones were of such stupendous size and dimensions as would test the best skill of the modern contractor to transport and put in place. This was accomplished by means of wooden rollers, ropes, and crowbars. In most cases no mortar was used, the stability of the building depending on the skill in the close joining of the stone blocks.

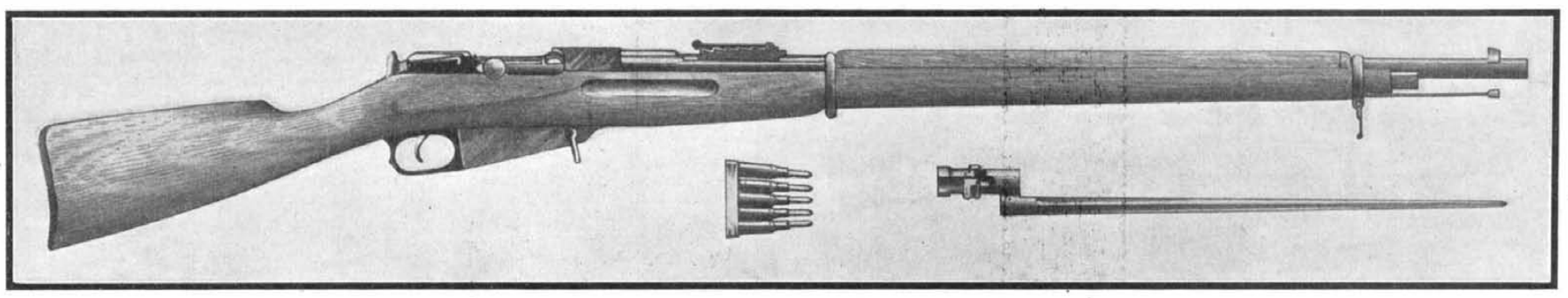
The government of the Incas is said to have been the most enlightened despotism that ever existed, and about the nearest approach to a Utopia which has yet been reached by any people. There was allotted to each man, free of charge, a dwelling site and extended area of land for him to till and cultivate for the maintenance of his family. The surplus of products from this tract, left over from the immediate needs of the owner, was given as tribute to the Inca government, and used for religious, charitable, and other purposes at their sovereign city of Cuzco. Under their wise and just civic administration, crime and public corruption and theft were not known. In Cuzco it is stated that a resident with one hundred bars of silver and gold piled up in his house, left it wide open, only placing a small stick across the door as a sign that the master was out—and nobody went in. Agriculture was the chief pursuit followed. Cotton, beans, maize, and coca were raised by the coast people. On the plateau the domestication of the llama and alpaca was the favorite occupation.

The whole tribe was divided into numerous clans. The powers of administration were centered in the elective dignitaries, a military leader, and the head of the religious system. There was also a council of chiefs. None of these offices were hereditary, and could not be occupied by sons unless they were specially chosen for the position. The succession of the chief Inca did not fall upon the shoulders of his child. This was due to the clan organization, which governed the affairs of state. Inheritance was by mother-right. A man could not marry a woman of his own clan, but had to select one from another. This was the main unit for holding the tribe together. Woman had no voice in public affairs, but ruled supreme in the home. She was admitted to esoteric societies, of which there were many. They also practised healing and became priestesses. Many complicated and elaborate ceremonial and religious rites were observed, and frequent sacrifices offered up to their deities. The Incas, under their enlightened system of government, had, however, incorporated in their religious worship some uncanny customs. Human sacrifice was practised, and on certain occasions a number of young maidens captured from other tribes were offered up to some of their principal deities. These young women were for a long time kept prisoners, and during the interval were employed at making pottery and weaving gorgeous fabrics out of the silk-like threads of vicuna wool for the sacrificial celebration. Owing to their extensive religious code, feasts and offerings of some kind were of almost daily occurrence, and the preparation for and observance of these occupied a great deal of the time of the people. Contrary to statements hitherto made, the sun was not the chief object of worship, but the moon, stars, thunder, lightning, and many natural objects and phenomena were included in the religious code. In Cuzco some forty different shrines existed.

What height Inca culture might have reached had it been allowed to follow a natural course of development is one of conjecture and speculation. Judging from their cyclopean architectural remains, and from the splendid examples of their technique, which is so strikingly displayed in the specimens obtained, it seems most likely that they would have kept abreast of the ancient Mexicans.



Details of Breech Mechanism.



Length of gun with bayonet, 5.7 feet. Weight, 9.5 pounds. Caliber, 0.27 inch. Initial velocity per second, 2,035 feet. Sighted to 1,600 yards. Weight of cartridge, 390 grains.

THE RUSSIAN ARMY RIFLE.

THE SMALL ARMS OF THE RUSSIAN AND JAPANESE ARMIES.

The contest between Russia and Japan will prove fertile in military instruction. Two intelligent, brave, and well organized adversaries have now met in the full shock of battle and tactics and new weapons are going to have something to say. In order to appreciate the results of future operations at their just value, it is necessary to be well informed as to the armament of the forces that are arrayed against each other, and to give such information is the object of this article.

RUSSIA.

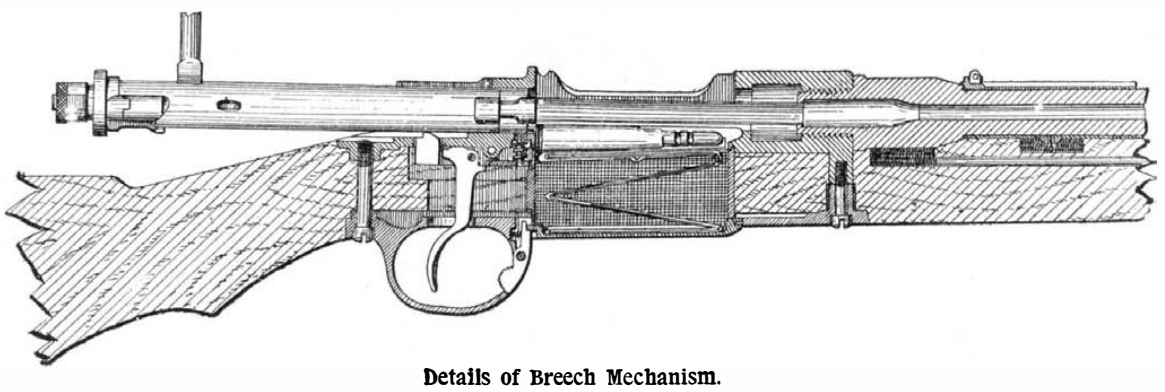
Armament of the Russian Infantry.—The gun is that of Col. Mossine, of the Russian artillery, and bears the name of "3-line (.275-inch) gun of the 1891 type." It is a repeating arm with a central magazine for five cartridges.

The barrel is 30 inches in length and has four grooves directed from left to right. The breech box, which is screwed to the rear of the barrel, is provided on the side to the left with a piece that performs the double rôle of a cartridge shell ejector and an isolater between the cartridge introduced into the chamber and the cartridges of the magazine. The movable breech is of the bolt type and swings back at the side. The magazine consists of a box formed of two lateral walls and closed by a cover at the lower part. It contains the elevating mechanism, formed of a lever jointed to the cover and a plate jointed to the lever. Two springs tend to raise the latter and the plate respectively. It receives a loader provided with five cartridges. If it be desired to use the gun as a single-shot weapon, the magazine must contain but four cartridges, and care must be taken to press the upper cartridge with the finger in order to permit the movable head to pass over its flange. The stock is of walnut or birch and is provided with the usual accessories. The breech-sight is stepped and provided with a slider. It is graduated upon its right-hand side into hundreds of paces (28 inches) from 400 up to 1,200. The movable plate likewise is graduated into hundreds of paces, from 1,300 to 1,600. Its movable slider, which is held in place by a spring, serves for indicating distances.

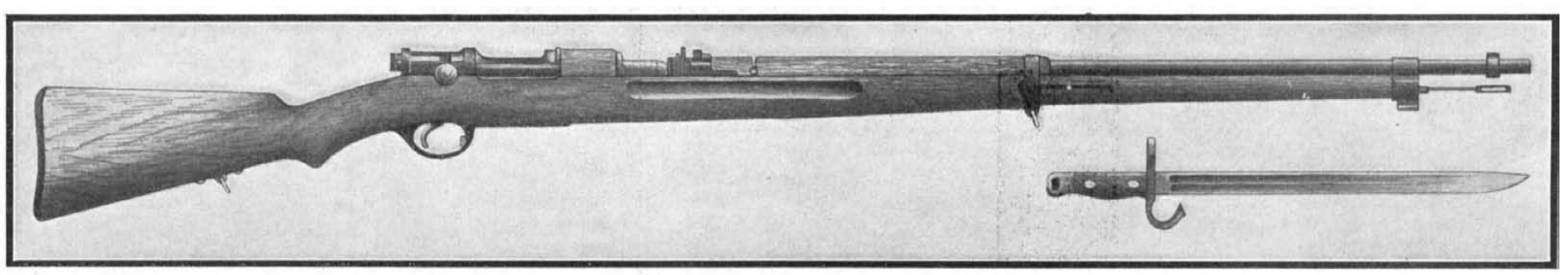
The bayonet comprises a quadrangular blade, which becomes progressively narrower toward the point, and the usual socket and catch, and remains fixed at the end of the barrel, even during firing. The cartridge comprises the shell, primer, powder-charge, and ball. It has no wad. The shell is of brass and provided with a flange. The primer contains fulminating powder covered with a disk of tin. The charge consists of thirty grains of smokeless powder of a basis of gun-cotton. The ball, which is of hardened lead, with a German-silver jacket, weighs 310 grains and is 4 calibers (1.2 inch) in length. The total weight of the cartridge is 390 grains, that of the loader, when empty, 147 grains, and that of the same when loaded, 4.25 ounces. The elevation of 00 paces corresponds to the line of fixed aim constituted by the sight-plate folded. It gives a sweeping trajectory up to a distance of 600 paces. It is employed when there is no time to spare to give the exact elevation, up to 600 paces, against infantry and 800 against cavalry. In such a case the marksman aims at the upper half of the object.

Firing by volleys is employed at all distances, and individual firing up to 600 and even 1,200 paces, if it is concentrated by groups of marksmen upon the same point. Rapid firing is done at the command of "Rapid fire!"

Complementary Data.—Initial velocity, 2,035 feet; maximum pressure per hundredth, 4,400 pounds; pitch of the trajectory at 1,970 feet, 72 feet; length of the gun without bayonet, 4.25 feet; length of the gun with bayonet, 5.7 feet; weight of the gun without bayonet, 8.8 pounds; weight of the gun with bayonet, 9.5 pounds. The number of cartridges carried by the Russian foot soldiers is 120, partly in two cartridge boxes secured to the belt, and partly in the knapsack.



Details of Breech Mechanism.



Length of gun with bayonet, 5.4 feet. Weight, 9.6 pounds. Caliber, 0.25 inch. Initial velocity, 2,378 feet. Sighted to 2,000 yards. Weight of cartridge, 336 grains.

THE JAPANESE ARMY RIFLE.

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JAPAN.

Armament of the Japanese Infantry.—Japan made war upon China in 1894 and 1895 with the guns of Engineer Mourata of the 1880 and 1887 types, having a caliber respectively of 0.4 and 0.3 of an inch. These guns at present arm only the troops of the second line. The new gun is due especially to Col. Arisaka. It is of the type of 1897, and is manufactured at the Tokio works. Like the Russian gun, it is a repeating one and of small caliber (0.25 of an inch), and with a central magazine for five cartridges. It belongs to the Mauser type.

The barrel, which is 31 inches in length, is provided with six grooves turning from left to right. The breech-sight is mounted upon it by means of a long sleeve, the upper part of which, flattened and hollowed, forms its foot; and the prismatic muzzle-sight is secured to a small hoop that surrounds the tapering end of the barrel.

The movable breech is of the bolt system, and turns back upon the side. The magazine, closed at its lower part by a cover, contains an elevating plate actuated by a spring. If the magazine is empty, this plate places itself in front of the movable head after the opening of the breech, and consequently prevents the closing of it. The object of this arrangement is to notify the soldier that the magazine contains no more cartridges. The recharging is done by means of a brass charging plate provided with five cartridges.

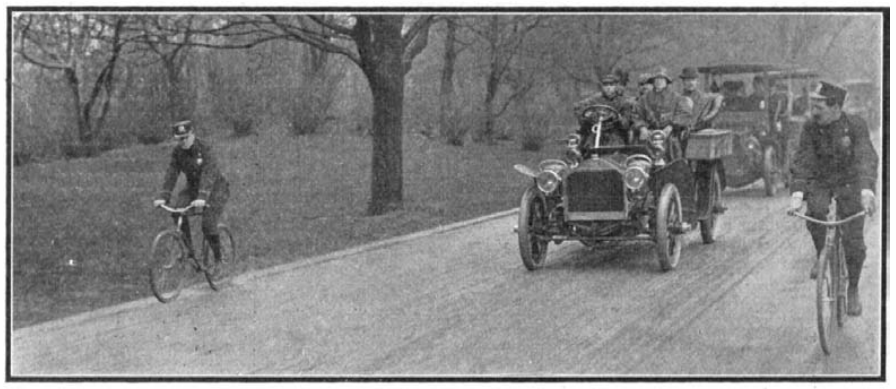
The mounting calls for no particular notice. The stock is formed of two pieces.

The breech-sight has no steps. Its plate is graduated from 400 to 2,000 yards. Up to 400 yards, the soldier makes use of a notch formed in the heel of the plate near the joint. Beyond this he employs the notch of the slider and the two notches of the plate. The slider is fixed at the proper division by means of a small click of which the tooth is held in the corresponding notch formed upon the side of the plate, by means of a spiral spring. The saber-bayonet has a 21-inch blade with a simple bevel and hollowed sides.

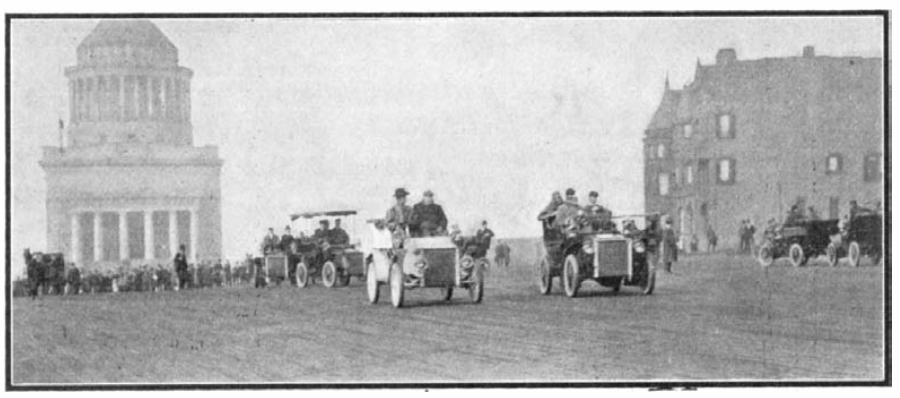
The cartridge comprises a shell, a primer, a charge, and a ball. The shell is of brass with a very convex cap; the primer contains fulminate covered with tinfoil; the charge consists of 32 grains of Itabaski smokeless powder distributed in scales and strongly plumbagoed; the ball, which is of hardened lead, with a German-silver jacket, weighs 158 grains and is 1.25 inches in length. The total weight of the cartridge is 336 grains; that of the charging plate, empty, 128 grains, and full, about 4 ounces. The charging plates are united in threes in cuneiform cardboard boxes weighing 12 ounces each.

Complementary Data.—Initial velocity, 2,378 feet; pitch of the trajectory at 500 yards, 3.87 feet; length of the gun without bayonet, 4.16 feet; length of the gun with bayonet, 5.44 feet; weight of the gun without bayonet, 8.6 pounds; weight of the gun with bayonet, 9.6 pounds; penetration of spruce at 130 feet, 7.5 feet.

The number of cartridges carried by the Japanese foot soldier is 120 (as in Russia), partly in two cartridge boxes and partly in boxes in the knapsack.



THE DIVISION OF FOREIGN CARS AND RACERS IN CENTRAL PARK.



DIVISION OF WHITE STEAM CARRIAGES MAKING THE TURN AT GRANT'S TOMB.

NEW YORK'S SPRING AUTOMOBILE PARADE.

What was undoubtedly the longest procession of automobiles that has as yet been seen in this city was that which went through Central Park and up Riverside Drive to Grant's Tomb and back on Saturday, April 30. Though the parade was obliged to start in a pouring rain, 142 pleasure vehicles entered Central Park at about 2:30 P. M., and passed through and out at Seventy-second Street at a speed of seven miles an hour. One of our illustrations shows one division of the parade, headed by bicycle policemen, on its way through Central Park. The first car in this division was a gasoline Locomobile.

On emerging from the park at Seventy-second Street, the parade was enlarged by 73 commercial vehicles and trucks, so that altogether there were 215 automobiles in line. Our second photograph was taken at the turning point near Grant's Tomb. It shows the White steam carriages, which were the only steam machines in line, and which, as usual, made a fine showing.

The machines went so slowly through the park, in order to keep within the seven-mile speed limit, that some of the larger ones had trouble with the water boiling in their radiators, and were consequently obliged to drop out of the procession.

About thirty machines had canopy tops, but the majority of the automobilists had to brave the rain. One of the large covered Panhard machines was driven by a lady, who had with her three lady friends. Altogether, about twenty women rode in the parading cars.

If the weather had been fair, it is probable there would have been four or five hundred automobiles in line. Considering the weather conditions, a very good showing was made.

The first asphalt pavement was laid in Paris in 1838, and since then the demand for this purpose has warranted an annual production throughout the world of 450,000 to 500,000 metric tons of asphaltum and bituminous rock. The consumption in the United States alone in the year 1903 was over 250,000 tons, which is equivalent to more than one-half of the average production in the world.

RECENTLY PATENTED INVENTIONS.

Hardware.

PIPE OR BAR CUTTER.—W. T. SNELL, Octave, Ariz. An object of Mr. Snell's invention is to provide a cutting-tool which may be adjusted to fit and securely clamp any size bar or pipe while the cutting operation is being proceeded with, the arrangement of the parts being such that the size and depth of the cut made by the tool may be regulated, depending entirely on the force or pressure exerted through the handle by the operator.

Heating and Lighting.

GAS-HOLDER.—J. H. COKE, Black Diamond, Wash. The leading feature of this invention resides in means for containing any quantity of gas under high pressure and for automatically reducing and regulating this pressure as the gas is fed to the point of consumption. This enables the gas, particularly in case of acetylene, to be used at a point removed from the point of generation, and by enlarging the capacity of the principal or high-pressure reservoir the periods between the recharging of the gas-holder may be extended to any reasonable length.

ACETYLENE-GAS GENERATOR.—G. A. BIDWELL, Pittsfield, Mass. In this patent the invention pertains to improvements in acetylene-gas generators, an object being to provide a generator of simple construction and having means for automatically feeding the carbide in determined charges or quantities, thus making the generation of gas practically continuous and under even pressure.

Machines and Mechanical Devices.

LIQUID-DISPENSING APPARATUS.—W. B. COCHRANE, Chicago, Ill. This apparatus is constructed to allow bottles or packages to be contained therein at one time although the liquid contents of the packages may be individually drawn off by the manipulation of suitable valves. Each bottle or package is held airtight in engagement with a stopper, and the package is supported by a form of holder which can be manipulated so as to readily dismount an empty bottle and replace it by a filled bottle.

ILLUMINATOR FOR SEWING-MACHINES.—P. ENGLUND, Chico, Cal. In this case the invention refers to an illuminating device for lighting sewing-machines and analogous structures. Mr. Englund's particular idea is to produce a simple, efficient, and reliable illuminator for use upon sewing-machines and to a great extent controllable at will by the operator so as to attain the best distribution or concentration of light upon any desired object on any part of the table.

CONTROLLING DEVICE FOR MAINTAINING STEADY PRESSURE.—T. P. FORD, New York, N. Y. This device is of that class that are used for operating dampers of boilers or for starting and stopping pumps employed for pumping water into overhead tanks and the like. The device is exceedingly sensitive and is arranged to work quickly to change the position of the stopping and starting mechanism of the pumps, damper, or other device to be controlled.

MEASURING APPARATUS.—C. R. HUDSON, Warren, Ind. The invention comprises a peculiarly-arranged instrument adapted to be used in connection with a line descending into the well and to indicate the depth to which such line descends. Preferably the instrument is used in connection with the sand-line which is attached to the bailer of the well-driving apparatus; but the invention is not limited to such connection.

PLANER.—E. RAWSON, Moscow, Idaho. In this instance the improvement relates to woodworking machinery; and the object is to provide a planer arranged to permit a slow or fast feed of the material to be treated in either a forward or backward direction and to allow convenient adjustment of the feed-rolls and the cutter-head to treat materials of different thicknesses without stopping the machine.

MACHINE FOR SEWING CORSETS.—S. ROYLE, 56 St. Andrews road, Southsea, Hants, England. Mr. Royle's object is to provide means whereby the piece of fabric to be united will be simultaneously felled by the folding inward to a definite extent and in opposite directions of their cut edges and at the same time overlapped to the exact extent required and united by the double line of stitching in such manner that the configuration of the corset when the parts are united will be determined by the contour of the cut edges of the component parts.

MUSIC-LEAF TURNER.—C. THOMA, JR., Carlstadt, N. J. One purpose of this invention is to provide a construction of turner and one which will not injure the page or sheet of music in connection with which it is used, and, further, to provide a conveniently-accessible means for turning one leaf after the other, each leaf being independently turned by a single movement of the hand, which movement will necessitate the removal of the hand from the keyboard for only a fractional portion of a second of time.

CEMENT-PLASTER KETTLE.—C. H. MALONE, Acme, Texas. The present invention is an improvement in kettles for cooking gypsum in order to convert the same into cement-plaster. Means are provided that are highly advantageous in many directions such, for instance, as, preventing the kettle from burning; carrying off steam and dust that may accumulate in cooking the raw material; and securing the benefit of the heat to cook the plaster with less fuel than in the ordinary kettle now employed.

Of Interest to Farmers.

FENCE-POST.—M. C. WIX, Milburn, Ky. In this patent the improvement refers to fence-posts, and it consists of a special post, having peculiar wire fastenings, whereby the fence-wire strands are effectively secured to the posts. The strand is passed into a pocket of a slot and when a hook device is adjusted to the limit of an elongated slot on its securing-pin a bill of the hook device will pass over the strand-wire and drop to engagement therewith.

GRAIN-SCREEN.—F. FREDEEN, Taylors Falls, Minn. In this case the improvement is in that class of grain screens or sieves which are provided with transverse slats pivoted in such a manner as to adapt them to be adjusted at different angles. Mr. Fredeen has devised certain novel features whereby the screen or sieve is free from some objections to others of its class, and is superior in other points.

COMBINED GRAIN THRESHER AND SEPARATOR.—F. FREDEEN, Taylors Falls, Minn. This machine is an improvement in that class of threshers and separators in which a series of horizontal tooth-bars are connected with transverse crank-shafts in such manner that they receive the combined up-and-down and forward-and-back movement, whereby the mingled straw and grain received from the threshing-cylinders are conveyed rearward and the grain separated from the straw in the course of its progress.

WIRE FENCE.—W. B. HUGHES, Dallas, Texas. The present invention is an improvement in wire fences, and particularly in that class of such fences which employ line-wires composed of strands twisted together to form a twisted cable, and the invention relates particularly to the connection between the fence-stays and the cables.

Prime Movers.

COMPOUND ENGINE.—S. ROTHSCHILD, New York, N. Y. The object of the invention is to provide an engine which is very compact, easily started and reversed, and arranged to utilize the motive agent to the fullest advantage. The special arrangement is such that the low-pressure cylinder not only contains the low-pressure piston, but also the high-pressure cylinder.

Pertaining to Vehicles.

DUMPING-CART.—S. GANTZ, Hagerstown, Md. The present invention is an improvement upon the dumping-cart for which Mr. Gantz received former Letters Patent. The invention provides a means for shifting the relative positions of the axle and body whereby in dumping the axle is drawn forward of its normal position to facilitate the tilting of the body.

Of General Interest.

NON-REFILLABLE BOTTLE.—A. OULLIÉ, 83 Rue Blanche, Paris, France. In this patent the improvement has reference to non-refillable bottles; and it consists of a system of plugs or obturators for preventing bottles carrying good marks or labels from being fraudulently filled with a view to deceive the consumer as to the origin of the liquid contained in the bottle.

COMBINATION COLLAR AND CUFF BUTTON.—A. E. STRANG, Canton, Ohio. The inventor provides a button of a construction by which the parts thereof may be readily reversed and applied or fitted together to adapt the button for either of the uses for which the same is primarily intended, and a button which is light in weight, besides being strong and having a capacity for long and continued service. The structure of the button may be readily altered or changed to either form without loss of time and with comparatively no labor.

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BOOT OR SHOE FOR ATHLETIC PURPOSES.—P. A. VAILE, Auckland, New Zealand. This article of footwear is intended to be worn by persons when engaged in physical-culture exercises or for other purposes and especially designed to develop the muscles of the legs, ankles, and feet. The leading feature resides in the application of a weight to the toe portion of a boot or shoe adapted to athletic purposes, the weight being disposed above the upper. Different weights are interchangeable to suit the strength and requirements of the user.

NOTE.—Copies of any of these patents will be furnished by Munn & Co. for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

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READ THIS COLUMN CAREFULLY.—You will find inquiries for certain classes of articles numbered in consecutive order. If you manufacture these goods write us at once and we will send you the name and address of the party desiring the information. **In every case it is necessary to give the number of the inquiry.**

MUNN & CO.

Marine Iron Works. Chicago. Catalogue free.

Inquiry No. 5487.—For makers of thinners and driers for tar paints.

AUTOS.—Duryea Power Co., Reading, Pa.

Inquiry No. 5488.—For parties to manufacture small cabinet or till locks,

For logging engines. J. S. Mundy, Newark, N. J.

Inquiry No. 5489.—For a machine that adds only; one that adds column at a time and does not carry; that is key-operated, having 9 or 10 keys, not a total adder, but only to run up a long column of figures.

"U. S." Metal Polish. Indianapolis. Samples free.

Inquiry No. 5490.—For makers of special machinery for a large factory for cereal foods.

Sawmill machinery and outfits manufactured by the Lane Mfg. Co., Box 13, Montpelier, Vt.

Inquiry No. 5491.—For a hand machine for forming heavy wire eyes and hooks of 3 or 4 inches long.

Profitable adding machine business for sale. Particulars 422 West Side Ave., Jersey City, N. J.

Inquiry No. 5492.—For a toy hull in which can be placed a small electric motor, about 3 feet by 6 or 8 inches.

American inventions negotiated in Europe. Wenzel & Hamburger, Equitable Building, Berlin, Germany.

Inquiry No. 5493.—For the manufacturers of the Rockwell rotary furnaces.

In buying or selling patents money may be saved and time gained by writing Chas. A. Scott, 340 Cutler Building, Rochester, New York.

Inquiry No. 5494.—For manufacturers of philosophical instruments.

☞ Send for new and complete catalogue of Scientific and other Books for sale by Munn & Co., 361 Broadway New York. Free on application

Inquiry No. 5495.—For a complete outfit for making horseshoes.

The largest manufacturer in the world of merry-go-rounds, shooting galleries and hand organs. For prices and terms write to C. W. Parker, Abilene, Kan.

Inquiry No. 5496.—For the address of a manufacturer of glass tanks for holding acids.

The celebrated "Hornsby-Akroyd" Patent Safety Oil Engine is built by the De La Vergne Refrigerating Machine Company. Foot of East 138th Street, New York.

Inquiry No. 5497.—For makers of electrical welding machinery, for welding small wires, No. 6 and finer; also for dynamos suitable for the above.

Manufacturers of patent articles, dies, metal stamping, screw machine work, hardware specialties, machinery and tools. Quadriga Manufacturing Company, 18 South Canal Street, Chicago.

Inquiry No. 5498.—For manufacturers of tools and materials for making rubber stamps.

Manufacturers: We can satisfactorily represent and handle your account. Correspondence invited. Welhener-Patrick Company, Manufacturers' Agents, 172 Washington Street, Chicago.

Inquiry No. 5499.—For makers of armature core punchings in sheet metal, of the ring type.

WANTED.—To manufacture on reasonable terms anything in wood or metal. First-class facilities for manufacturing and shipping. Satisfaction guaranteed. Send samples for estimate. Wayland Incubator & Manufacturing Co., Wayland, N. Y.

Inquiry No. 5500.—For clocks for a factory, which are electrically controlled from one master clock.

FOREMAN WANTED.—A thoroughly capable man to take charge of brass shop employing about fifteen men. Must be between 30 and 40 years of age, married. Reply by letter only, stating experience and references to Wm. H. Wilkinson Co., West Medway, Mass.

Inquiry No. 5501.—For the makers of the "Merritt" typewriter, or dealers in repair parts therefor.

Inquiry No. 5502.—For parties engaged in the manufacture or designing of clock cases.

Inquiry No. 5503.—For manufacturers of light wooden and metal specialties.

Inquiry No. 5504.—For manufacturers of vulcanized fiber specialties.

Inquiry No. 5505.—For manufacturers of machines for turning and boring hub blocks.

Inquiry No. 5506.—For manufacturers of balloons.

Inquiry No. 5507.—For woodworking machines for such work as dowels, skewers, etc.

Inquiry No. 5508.—For manufacturers of heavy corded webbing.

Inquiry No. 5509.—For machinery for making earthenware water pipes.

Inquiry No. 5510.—For the address of the Furber Patent Shoe Company.

Inquiry No. 5511.—For the address of the U. S. Silver Co., also of the Crown Silver Co.

Inquiry No. 5512.—For manufacturers of machinery for making tooth brushes.

Inquiry No. 5513.—For the address of the Pyle National Electric Headlight Co.

Inquiry No. 5514.—For makers of a bower-barfing equipment,

HINTS TO CORRESPONDENTS.

Names and Address must accompany all letters or no attention will be paid thereto. This is for our information and not for publication.

References to former articles or answers should give date of paper and page or number of question.

Inquiries not answered in reasonable time should be repeated; correspondents will bear in mind that some answers require not a little research, and, though we endeavor to reply to all either by letter or in this department, each must take his turn.

Buyers wishing to purchase any article not advertised in our columns will be furnished with addresses of houses manufacturing or carrying the same.

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Scientific American Supplements referred to may be had at the office. Price 10 cents each.

Books referred to promptly supplied on receipt of price.

Minerals sent for examination should be distinctly marked or labeled.

(9390) D. M. S. asks: Certain makers of automobiles who use the "planetary" type of gearing in their machines state, as an important point in the construction of their particular gear, that no *internal* gears are used. Why is the internal gear objectionable? And cannot an internal gear, if properly designed, be successfully used in an automobile speed gear? A. There is no inherent objection to the use of internal gear wherever its special construction and application is desirable, for its use is a most important adjunct in many machines; possibly the necessary compactness of a speed gear makes the outside gear preferable.

(9391) W. B. asks: 1. Which is the cathode—the place where the electricity enters the vacuum tube, or where it leaves? A. The cathode in a vacuum tube is the place at which the electric current leaves the tube. 2. How do they make liquid air? A. The process by which the air is liquefied is in general as follows: The air is compressed and cooled, dust and other solid matter removed from it, then dried or deprived of its moisture, and then passed to the liquefying coils under a pressure of 2,500 to 3,000 pounds to the square inch. From a specially constructed valve the air is allowed to escape and expand. It passes back along the outside of the coil through which the compressed air has passed on its way to the expansion valve. By its expansion it is gradually cooled, and in turn cools the compressed air in the inner pipe. In this way the cooling proceeds by successive stages until the temperature of liquefaction is reached, and a portion of the air then collects in a liquid form in the bottom of the machine. You will find the process fully described in Sloane's "Liquid Air," which we can send you for $2.50 postpaid.

(9392) I. B. R. asks: Since in an ordinary electric railway system with an overhead trolley wire the circuit is completed through the rails, why is there not the same danger from contact with them as from the third rail in the three-rail system? A. The third rail in an electric system is insulated from the earth, and if one comes in contact with it while he is still in contact with the ground, he will receive the shock due to the current which passes through him from the rail to the earth, just as he would if he could make contact between the trolley wire and the ground, the trolley wire carrying a current of the same voltage as the third rail. Now with reference to the other part of your inquiry: There is not the same danger of a shock by coming in contact with the rails of the track while standing upon the earth, as you must know, because everyone is continually stepping upon the rails as they cross the tracks of an electric line. The reason is not far to seek. The rails are bound together by strips of metal to furnish an easy path for the current back to the power house, and are also in contact with the earth during the whole of the distance; therefore, if one who is standing upon the earth steps upon the rail also, both the earth and the rail must be at the same voltage, since they are in contact with each other, and no current can flow from one point to another when both points are at the same voltage, any more than water can flow from one point to another when both points are at the same level. This is the reason why no shock can be received by a person who is standing upon the ground, and who touches the rails of the track through which at the moment the current may be returning to the power house.

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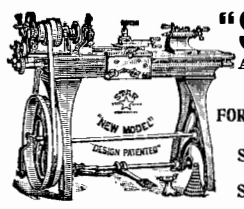

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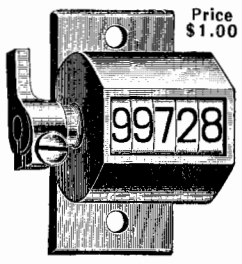

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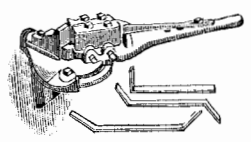

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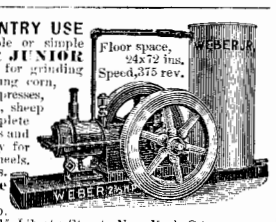

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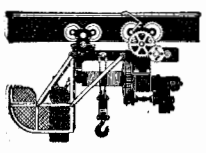

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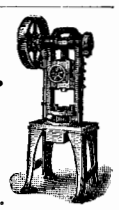

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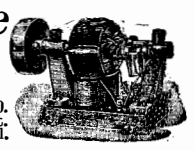

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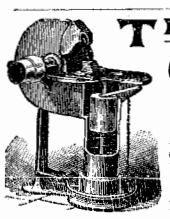

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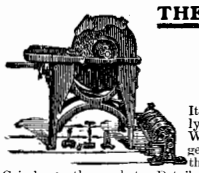

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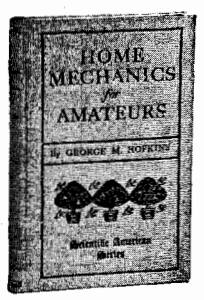

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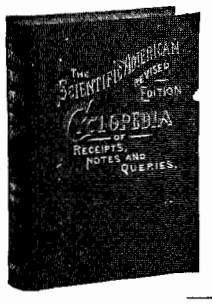

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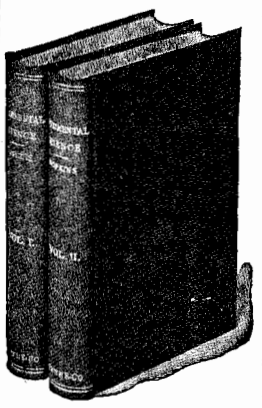

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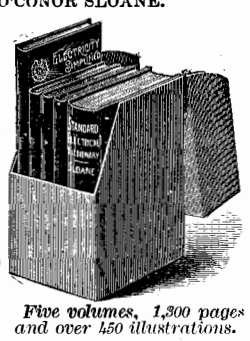

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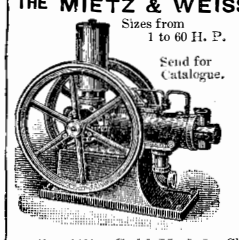

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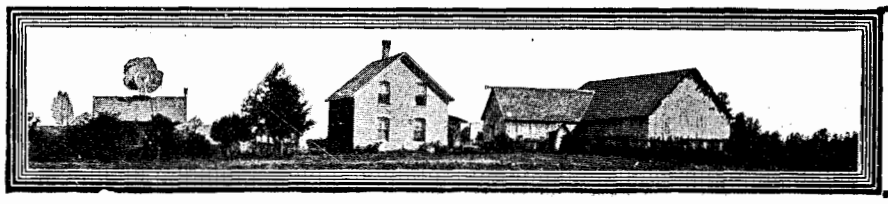

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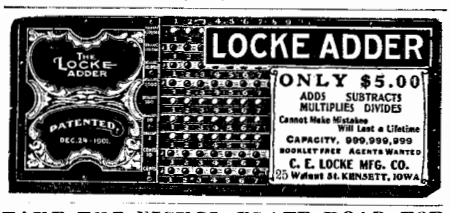

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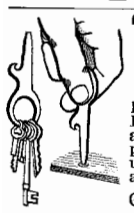

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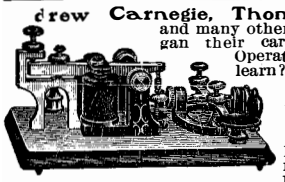

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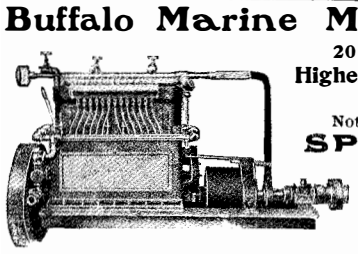

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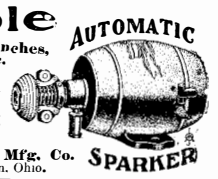

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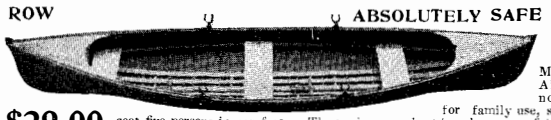

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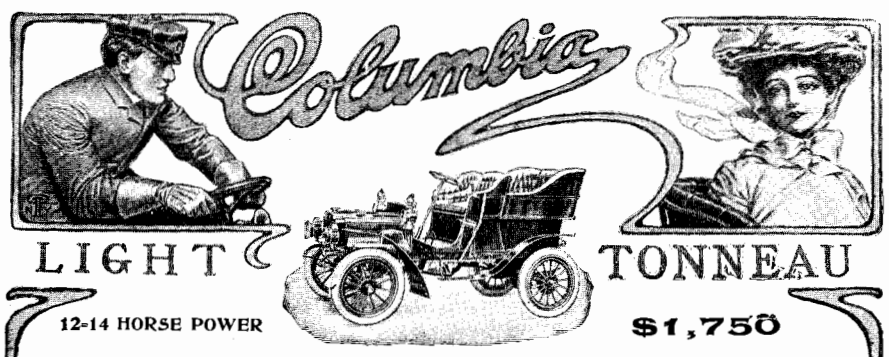

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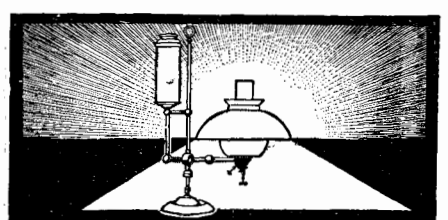

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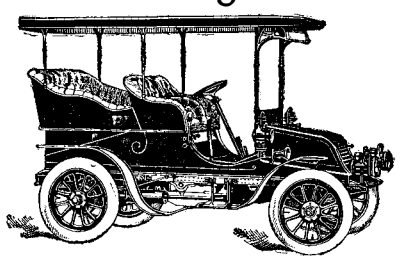

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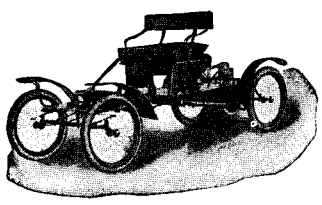

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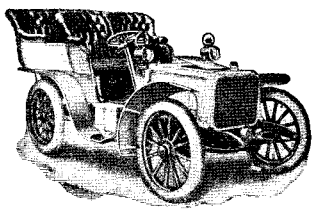

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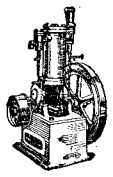

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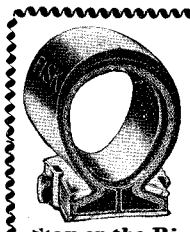

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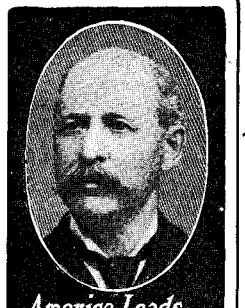

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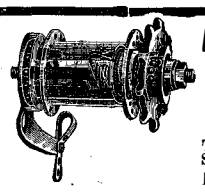

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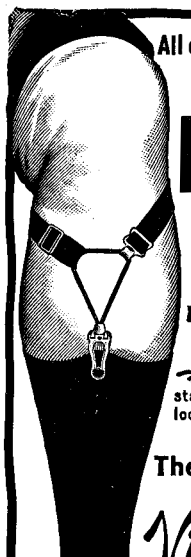

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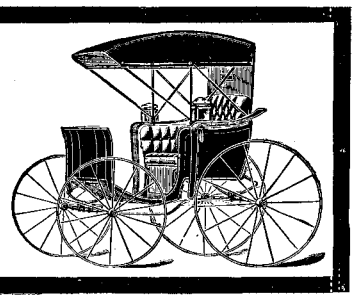

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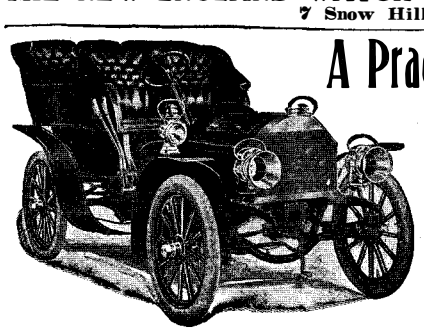

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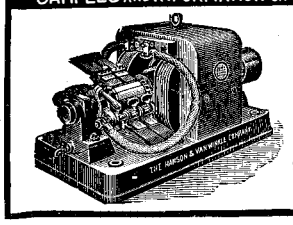

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